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ABSTRACT

This paper justifies the teaching of cartography in secondary schools and expands graphic knowledge by providing a formal graphic language simulation lesson. The cartographer's task, decisions, and methodologies are approximated by the use of this role playing scenario. Students assume the roles of map authors who are contracted to draw up a set of maps depicting the fire damage risk for the properties in a one block area of an industrial city. Using the materials provided--including photographs, census data, hydrant and fire alarm locations, traffic flow charts, and building locations--students familiarize themselves with the data and set about attacking the problem. The end products of their work are maps which are evaluated by the class to see who will be awarded a further contract. The final section examines the simulation for its value as a decision-making exercise, its conveyance of the cartographic system, and as a communication exercise in self-expression. (Author/DE)

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TITLE

CARTOGRAPHY AS LANGUAGE:
AN ARGUMENT
AND
A FUNCTIONAL APPLICATION

AUTHOR'S NAME

ELAINE FRANCES BOSOWSKI

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PRÉCIS
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People naturally communicate with words, numbers, and graphic symbols. However, only verbal and numeric languages are included as parts of a person's formal training in schools. This thesis is concerned with the need for formal graphic, and specifically cartographic, training. To introduce such training schools, a simulation-game is proposed. Materials and strategies for the simulation's use are discussed. The simulation is evaluated as an effective teaching-learning device through which people can become better graphic communicators.

To

Mano Mamytė

I

Mój Tatuś

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CHAPTER ONE

CARTOGRAPHIC LANGUAGE AND THE NEED FOR GRAPHIC FLUENCY

Education should provide the freedom for "men to come to feel like masters of their thinking by discussing the thinking and views of the world explicitly or implicitly manifest in their own suggestions and those of their comrades."

(Freire, 1971, 118)

In a world where day-to-day living relies on many kinds of interaction with other people, communication is essential. Communication through the cries and gestures of the infant give way to structured forms of language when we learn to use words, numbers and pictures to convey messages to others. Yet in schools, formal study time is only devoted to training in verbal language and numeracy or numeric language. A child may be taught something about drawing in school. However, he rarely receives formal training in graphic language that is comparable to that which he receives in the other two language forms. Graphic language, or "graphicacy . . . is the intellectual skill necessary for the communication of relationships which cannot be successfully communicated by words or mathematical notation alone; it is a skill to be possessed by both those wishing to communicate and those attempting to understand; visual aids, especially maps, photographs, charts and graphs, are the media of communication . . . Graphicacy is concerned especially, but not wholly, with spatial relationships as in maps." (Balchin and Coleman, 1966, 23-24) Verbal language and numeracy are used to help us organize the universe by naming and ordering the things we encounter in it. So too, maps as expressions of graphic language, aid us in establishing an order for things, places, and their relationships and interactions with each other. Graphic displays allow us to clearly communicate ideas that would be unmanageable with the two more common forms of communication.

Everyone uses verbal language, numeracy and graphicacy. Everyone learns to differentiate a variety of messages with words, numbers and graphic symbols. These processes begin at birth and continue naturally throughout our lives. The child who has never attended school can communicate to some degree in all three languages. Why, then, is it that years are spent studying only "Language Arts" and "Mathematics" in school classrooms? There are limits to one's abilities to use these languages, as well as graphic language. In school these limits are expanded to encompass the full power of communication commanded by a language. In school one learns the structure and function of any language in order to facilitate more accurate, more eloquent and more effective use of that language. One becomes not only skilled in sending more complex messages to others, but also capable of receiving and interpreting complex messages.

Everyone makes maps. Even the infant forms mental maps of the path to his mother's breast, to nourishment. Mapping is indeed a natural process; and like verbal language or numeracy, its full power as a communicative device is realized with a better understanding of its structure and effective use. Unlike other languages, the systematic study of maps and mapping, of cartography, is seldom taught in schools.

This thesis is aimed at finding ways to introduce and expand graphic knowledge through some formal graphic language experience, and justifying the teaching of cartography in schools.

Graphics as Language

It is of value to examine the similarity between verbal language and graphic language in greater detail. Although an analogy could be drawn with numeric language, to avoid unnecessary repetition the following discussion will deal with a comparison between verbal and graphic languages. The mechanics and purpose of graphic representation, as applied to the communication of a message, are analogous to the mechanics and purpose of other communication forms. Graphics, more specifically, cartography, can be compared with spoken and/or written language. For example, let us examine those things involved in the production of literary artifacts, novels, in relation to the components of the cartographic system which demonstrates the manner in which cartographic artifacts, maps, are produced. Any given literary or cartographic work has an author who is interested in communicating an idea and who utilizes a set of tools and rules to implement such communication. The literary author's tools are the words that make up his vocabulary. The rules to which he abides in using these tools include a word classification system that determines the parts of speech, and a set of regulations governing the relation and function of words according to established sentence usage. In other words, these rules compose the language's grammar. The tools used in producing a map are drawn from a variety of drafting, art, and photographic techniques available to the cartographer. The rules that govern the cartographer's use of these tools constitute graphic grammar. These rules describe a framework for the techniques involved in cartographic procedure, not unlike the literary author's classification of parts of speech. They dictate the use of each technique according to established research and practice.

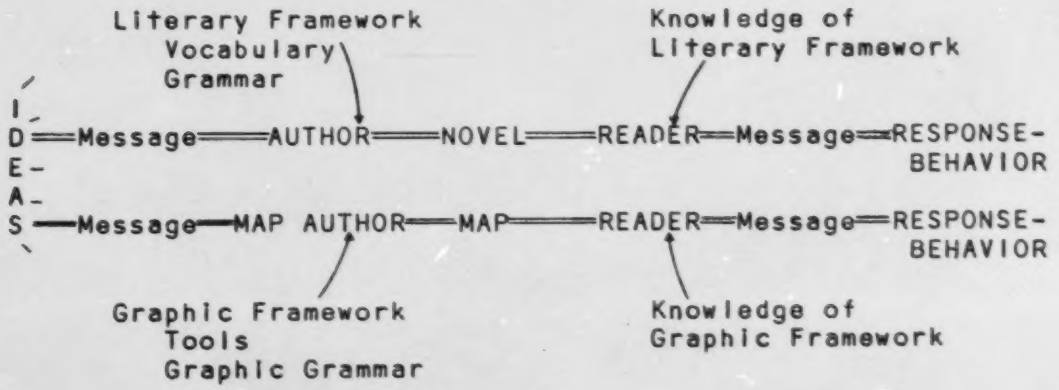
However, in the communication of an idea more than a set of tools and rules is needed. There must be some organization in both novel and map if they are to be successful in transmitting their message to a reader. Both novel and map can be analyzed in terms of a group of elements that make up the framework for every literary or cartographic work. These frameworks are shown on the following page in a diagrammatic layout which illustrates the correspondence between the elements of literary works and those of cartographic endeavors. Although such a comparison has never appeared in the literature, the relationships drawn in the diagram clearly demonstrate the similarity that exists between literary and graphic artifacts.

ANALYSIS FRAMEWORKS

LITERARY	COORDINATING VALUE	CARTOGRAPHIC
Author		Map Author (Cartographer)
Birth of novel Stating theme		Conception of map Defining "purpose"
Theme	unifying factor	Purpose
Plot	how unifying factor carried out	Graphic Structure
Person	from what perspective	Projection
Setting Description	where	"Area" Compilation
Characters	what's there	Data; data base
Characterization	how what's there is shown	Generalization
Symbolization	why things shown as they are	Symbolization (especially perceptual, connotative, subjective, and conventional aspects)
Atmosphere	how depicted	Design

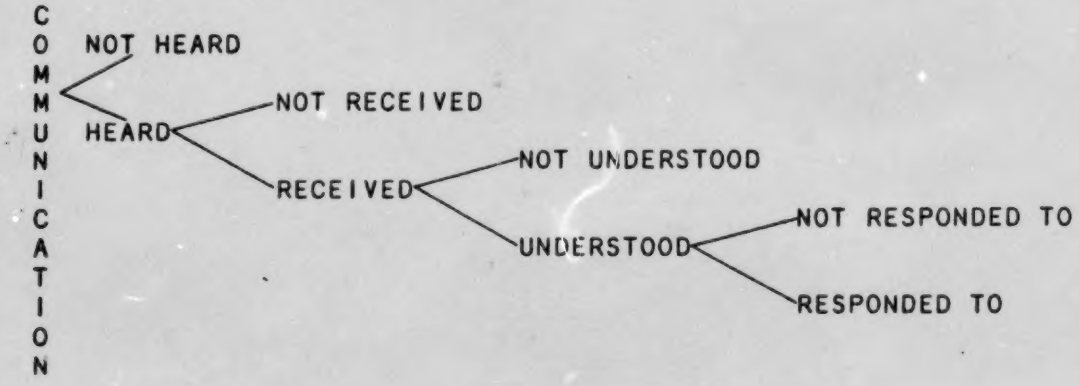
Communication is the successful merging of the harmonic use of tools, rules and framework to explicate an idea with the receiver's ability to comprehend such an idea. A diagrammatic representation of the flow of successful verbal and graphic communications follows.

COMMUNICATION



The model presented, however, does not reflect the effect of all literary or cartographic work. It shows only the desired result. For the literary work, the model comes closer to representing the actual situation of communicating the author's ideas than for the cartographic work. After all, children are trained in and made aware of their language tools throughout their lives, beginning at birth. Even if they do not learn about literary analysis, their knowledge of vocabulary and grammar affords them the necessary means for extracting some viable meaning from almost any literary work. Formal training in the use of cartographic tools and grammar, however, is lacking. A graphic artifact may indeed elicit some meaning without such training, but accurate interpretation is limited by the lack of graphic knowledge. Although some graphic symbols are generally understood even by untrained (e.g., symbols used to indicate "more" or "greater", "less" or "smaller"), abstract symbolization presents a problem. People are usually not trained to handle the interpretation of abstract symbols like dot maps, graduated circles, or graded shading patterns. Although some of the symbols used in literary works may escape the reader, it would seem that the literary author has a much better chance of putting his ideas across to a reader than the map author has because people are trained to read and understand, to become literate. One way to facilitate the map author's task is to help make the audience to whom he addresses himself an audience prepared for the language he uses in his communication. For, indeed, communication at its best is a reciprocal process.

Communication operates on a number of different levels. The optimal situation, communication as a reciprocal process, involves the positive functioning of all levels. In general, we can view that which happens to communication, or attempts to communicate, in the following ways.



First, communication may or may not be heard. However, a speech, a letter, or a map, even if never heard or seen can

still be referred to as communication. Once heard, communication is then either received or not received. Here we are concerned with whether or not the speech "goes in one ear and out the other", whether the letter or map is nothing more than seen. Received communication is understood when some message is extracted from it. Conversely, no extracted message means the communication is not understood. Finally, the true test of any communication is the response or the lack thereof, to the understood message. Response can yield whether or not the intended message was that which was extracted and understood. It is with response that the effectiveness of communication can be judged. A speech about the evils of pollution may spark the organization of an antilittering campaign; a letter may be answered; a map may successfully lead its user to a buried treasure. The optimal situation, communication as a reciprocal process, involves the positive functioning of all levels. That is, communication is at its best when it is heard, received, understood, and responded to, either in a manner that reflects the intended message or otherwise. The importance of response is to serve as feedback, positive or negative, for it is, in itself, communication.

When considering communication, we are ultimately dealing with not only the communication device, but we are also concerning ourselves with the sender, or author of the communication, and the receiver, the person to whom the communication is directed or in whose hands the same is found. Within the graphic/cartographic means of communication, the map cannot do it all, just as having spoken does not necessarily imply having been heard. Intended responses to communication rely on the receiver's understanding of the sender's message. Such understanding is fostered by the sender and receiver of a message having the abilities to use and interpret language forms common to both of them. In cartography this means that

> The language of graphic symbols should not only be understood by the map maker, but also by the map user. (Koeman, 1971, 174)

Only in this way is it possible for communication's ultimate state of reciprocity to be realized. For the map to elicit a response for which it was intended, the map must be constructed according to rules of graphic grammar what will be received and understood by those who use the map. We can thereby recognize the value in attaining some familiarity with, some command of graphic language as an aid in our understanding of graphic/cartographic communication. The problem to be treated next is how we might pursue the task of introducing the study of graphicacy to potential map users.

Graphic Grammar and the Spanish Teacher

There are a few obvious methods for introducing substantive cartographic knowledge in the classroom. A memorization technique could be applied to introduce students to cartographic terms. However, in this way, little practical knowledge in the use of cartography would be gained. The student would merely learn to spell and define terms for which true meaning could only be gained through experience, through working on things cartographic.

Another method for beginning study in cartography is the traditional "tell them all about it" lecture method. With a few slides it might even be possible to get across the fact that cartography involves the use of a specialized graphic language. Unfortunately, little more than this would be picked up by students. Without experience, the lectures would only be empty strings of sentences.

To introduce experience, students could simply DO cartography. Starting from the beginning, students could gather materials, work for months, and in the end produce a manuscript copy of a map. The time and effort required by this manner of instruction would hardly interest many, save perhaps the professionally oriented, those interested in making a living as cartographers.

So, dispensing with the professionally oriented technique of learning to "do it all" by "doing all of it", we could consider demonstrating cartography for a class. A kind of "show and tell" session in the "hows" and "whys" of map production could be run for students to observe. But how well can anyone sit patiently through hours of data gathering classifying, and selecting; let alone the compilation, drafting, photographing, and printing of a map. To accomplish the goal of familiarizing those who are unfamiliar with the cartographic system, the traditional, professional and obvious means of introducing a topic of study are hereby discarded.

In relinquishing the above, I do not, however, forfeit the concept of "learning by doing". For cartography, as for any language, "doing" is essential for learning. An analogy dealing with language instruction will be helpful in explicating this point. For example, let us consider the following discussion.

The traveling student of Spanish, desiring to communicate with Spanish-speaking people, need not become a Spanish citizen to learn to read a menu or to buy fruit in a Spanish market place. In the same manner, the student interested in acquiring basic ideas about the cartographic system need not don drafting tools and cartographer's guise to have a feeling for how a road map should be read. As the Spanish teacher prepares his students for the variety of situations they will encounter on a visit to Madrid, we , as cartography instruc-

tors, should prepare potential map users for the numerous graphic/cartographic representations with which they will come in contact throughout their lives. Graphic explanations of election results, the extent of military activity in Southeast Asia, the effects of one pain reliever over all others, the economic "state of the nation", the site of the new town dump, the nature of the moon's surface, the daily weather patterns for the country, etc., all permeate every aspect of the individual's life as means of communicating messages to him. We would do well to prepare the map user for recognizing the Mercator projection as a good navigational map, but a poor choice for comparing nations' relative sizes. The Spanish teacher does well in teaching that "¿Donde esta la casa de Miguel?" would probably result in directions to Michael's house--whereas "¿Como esta la casa de Miguel?" might only result in the response that it is a nice, sunny house, though small for the size of Michael's family. The distinction is clear to those of us who know what the Mercator projection is and to those of us who understand Spanish, but what about the others? The Spaniard who responds to the student's question, "¿Como esta la casa de Miguel?" cannot be responsible for not answering with directions to Michael's house. Just so, the cartographer who designed the Mercator map cannot be responsible for the map's being used for a purpose other than that for which it was intended. The student of Spanish and the map user must be equipped to translate their respective languages in order to make use of the Spanish dinner menu and the national road atlas.

From the analogy drawn between the Spanish teacher and the cartography instructor, strategies for introducing the study of cartography can be examined. First, observe that the methods previously reviewed in relation to cartography can also be applied to the teaching of Spanish with varying degrees of success in each case. The Spanish teacher would hardly expect that a word or two of Spanish would be picked up by students from a lecture about the language; but, then again, languages are never taught by talking about them anyway. Similarly, the teacher's demonstrating that he can speak Spanish hardly promotes the students' learning the language. Also, though memorization of rules and vocabulary is a traditional language education method, it would seem that the best way to learn to communicate in a foreign language is to do so, i.e., the conversational method. The fourth technique mentioned in reference to cartography calls for the student to "learn all" by "doing all"; the analogous student of Spanish would need to learn Spanish as thoroughly as, and in the same manner as, he learned his first language. This would, as was the case with cartography, produce an individual with a professional command of the language. But, student mastery or professional training is not the goal here. In-

stead, we seek a method of promoting a general understanding of how the respective languages can be and are applied in practical situations. For the Spanish teacher this might involve approximating a market place by designing scenarios of the Madrid market for students to act out. Thereby the students would be able to experience the market place situation without actually having visited Madrid or any place in Spain. The learning benefit of the scenario approaches that of the actual market place visit. If students play out a scenario asking a Spanish vendor for vegetables in their native tongue, they soon begin to have some sense of the types of vocabulary and phrases that are needed to communicate in such situations.

Likewise, the cartographic instructor could develop some approximation of the cartographic system to facilitate his teaching endeavors. Tackling the entire system in this way is a bit more extensive a project than can be completed within the scope of this paper. But surely some aspect of the system could be developed and dealt with in an educational framework as an alternative to those traditionally employed in cartographic instruction. The object here is not to train the professionally oriented student, where previously discussed methods may indeed be applicable; but rather, to consider a way to make the cartographic system familiar to the non-professionally oriented student. The cartographer's task, decisions, and methodologies can be approximated for the student by using scenario, role-playing, simulation and gaming techniques. We can refer to all of these as "simulations", for here this term "refers to the assumption of the appearance of something without having its reality." (Dawson, 1962, 1-2)

> Simulation, as a social science research technique, refers to the construction and manipulation of an <u>operating</u> model, that model being a physical or symbolic representation of all or some aspects of a social or physical process. Simulation, for the social scientist, is the building of an operating model of an individual or group process and experimenting on this replication by manipulating its variables and their interrelationships. (Dawson, 1962, 3)

Clearly, role-playing, scenarios and gaming fit into this definition. These experiential teaching-learning techniques can be used to help introduce the study of cartography in the classroom. By approximating a cartographic process through simulation we can effectively teach what that process involves. Note here that we are concerned with the notion of simulation as an "operating model" for a cartographic process used to facilitate experiential learning. We are concerned with simu-

lation not as a means to study a process, but rather as a means to teach a process.

It may be that simulations of the cartographic system prove intriguing to the professional as well as the non-professional cartography student. Simulation can present the cartographic system in its entirety for "experiencing", while the professional cartographer usually experiences only one aspect of the system at a time.

> In conventional secondary school social studies, the students may not learn as much or as deeply as in other subjects, because they cannot readily learn to be surprised at things without having some experience of how they ought to be.
> (Abt, 1968, 66)

A simulation would therefore serve to tie together the many pieces of the cartographic puzzle with which the professional has become acquainted. Yet, at the same time, this simulation could provide a relevant experiential introduction to cartography for the non-professional. Such a simulation, if its use were encouraged, eventually would lead the way to gra graphic fluency.

The nature of simulation promotes the internalization of a "sense" of process. Within any process, a simulation can be implemented to allow for the vicarious experiencing of some "real-world" situation within that process.

> If learning is based on experience and drawing analogies to previous experiences, it seems clear why the effective teaching of social studies is most difficult when only conventional techniques are used. (Abt, 1968, 65)

Essentially, by being able to "do", even though "doing" here is a simulated action, one is better able to learn.

Simulation, as a problem-posing educational technique, can unite teacher and student in a learning enterprise in which all participants grow. Paulo Freire makes an argument for problem-posing education in Pedagogy of the Oppressed, 1971. He states that in such education "no one teaches another, nor is anyone self taught. Men teach each other, mediated by the world, by the cognizable objects which in banking education are 'owned' by the teacher." (67)* But, as

---

*Here, "banking" refers to the more traditional forms of education where the objective is to fill the student with knowledge much the same as one would fill a bank account with money.

co-investigators in a problem, students and teacher become co-learners. Students, "posed with problems relating to themselves in the world and with the world, will feel increasingly challenged and obliged to respond to that challenge." (68-69) Eventually the student will be committed, committed to his own education. "Problem-posing education bases itself on creativity and stimulates true reflection and action upon reality, thereby responding to the vocation of men as beings who are authentic only when engaged in inquiry and creative transformation." (71) Such education "affirms men in the process of becoming" (71); it allows the individual to become aware of how his life relates to the world, and how the world relates to him. Dialogue and critical thinking are essential to this process of becoming. "Dialogue is the encounter between men, mediated by the world, in order to name the world, . . . (it) cannot exist . . . in the absence of a profound love for the world and for men." (76-77) Dialogue founded on love, humility and faith yields a mutual trust that is communication. Without dialogue and critical thinking there is no communication, and without communication there can be no education.

Promoting Graphic Fluency

Within an educational institution, one way to foster the type of dialogue and communication about which I have been speaking is through open classroom, experiential learning situations. Simulations, including role-playing, scenario, and gaming techniques are ways in which some of these situations can be introduced into the classroom. These methods have been used to teach verbal languages. Based on the analogy drawn in this chapter, it would seem reasonable that such methods would be applicable to cartographic instruction. Simulation may be the very vehicle we need to promote graphic fluency. Indeed, anything would seem to aid the promotion of graphic fluency or graphicacy, since, at present, nothing is done.

However, there are a few avenues we should explore to allow us to get a grip on what cartographic language involves before we attempt discussing how to teach it. Therefore, a model of the cartographic system is presented in the following chapter. A functional description of the model stresses the dimensions of the problem of cartographic communication. The reflective nature of processes within the cartographic system is demonstrated and built upon as an argument for simulating some aspect of the system in a classroom activity.

In Chapter Three, a detailed set of alternative strategies for implementing such a simulation is given. The actual materials to be employed in the classroom are also included here. Essentially, with this chapter in hand, it becomes possible to introduce students to the decision-making

processes of the cartographer. Students assume the roles of MAP AUTHORS and are asked to solve a mapping problem. Using the materials provided, the students familiarize themselves with the task, ask questions, and discuss mapping strategies to satisfy the demands of the problem set out for them. The end products of their work are maps which are evaluated by the class, an evaluation based on notions inherent in the cartographic system. This chapter becomes the instructor's "teaching packet" for the simulation.

The final chapter consists of a three-level examination of the simulation materials and strategies as they relate to the model in Chapter Two. First, the simulation is examined as a decision-making exercise whose goal it is to demonstrate what is necessary to communicate an idea, a graphic message in this case. Second, the simulation is viewed on the basis of its consistency with and its value to the understanding of the cartographic communication system. In terms of the students' experiences, two questions might be asked.

> Does the simulation suggest the complex nature of cartographic processes?
>
> Does it provide for recognizing and encouraging "spin-offs" as areas for specific in-depth study of cartographic problems?

Insights to the complexity and confusion surrounding graphic artifacts are discussed as additional gains for participating in the classroom activities.

Finally, the simulation is explored as a communication exercise in self-expression, learning to express our thoughts to others in a manner most like that in which we understand such thoughts. The basis for this discussion is the thesis that by understanding the way in which someone communicates, we can better understand his communications. Thereby images of the environment are expanded and clarified. And, as a result of this, we "come to feel like masters of (our own) thinking" and we grow.

CHAPTER TWO

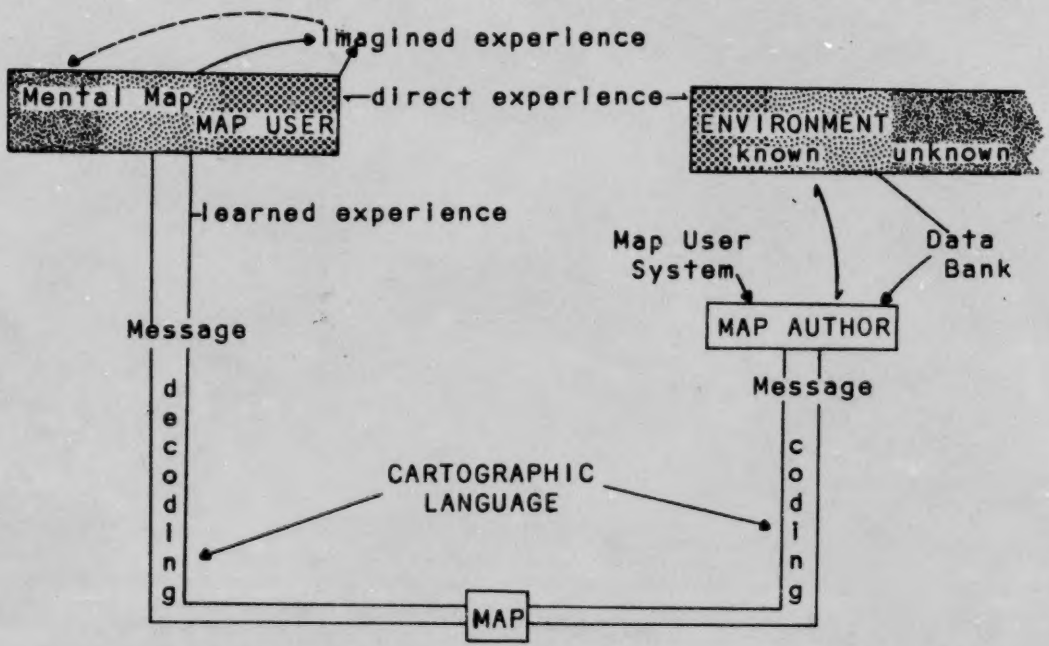
THE CARTOGRAPHIC COMMUNICATION SYSTEM

> . . . that you cannot navigate. . .
> without charts however does
> not mean that you can navigate. . .
> by charts alone--rudder and
> helmsman are also necessary.
> (Wright, 1942, 544)

Cartographic Language as System

Cartographic language, as used in communication, is probably most appropriately examined in terms of the part it plays in man's understanding of the environment, of "all that exists." Examination of cartographic language is facilitated by viewing the language as it functions in the understanding of a much larger whole, what I call the cartographic communication system. This system can be shown in a model, interrelating a complex set of elements as they are involved in the processes that underlie cartographic communication. Cartographic language is seen as an inherent part of the coding and decoding processes depicted. The model is shown below.

THE CARTOGRAPHIC COMMUNICATION SYSTEM

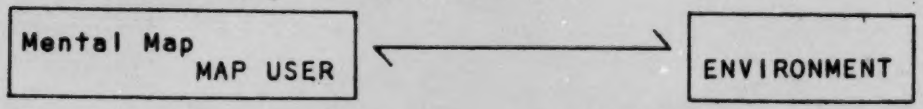


It is clear to see why the model is spoken of as a system; it represents a functioning whole. Because it is used to display cartographic communication, the model shows, in a general form, the elements and processes involved in the making and using of graphic representations of the environment for the purpose of communication. Communication requires dialogue. Here dialogue refers to a transfer of ideas which takes place between the map author and the map user. The map is the vehicle for their dialogue, and thus,

it is also the vehicle through which communication takes place. The topic of communication with which the map deals is the environment. Relationships among the map author, environment, map, and man, as the map user, constitute the functioning whole referred to as the cartographic communication system. In order to explain and demonstrate the functioning of this system in a more understandable form, there is value in showing the development of the model in a step-by-step description.

Mental Map as Natural Process

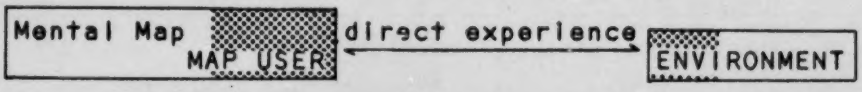
Man, as map user, exists in and interacts with the environment. These interactions are composed of experiences from which man extracts information, some of which is stored in his mind in some map-like form. Although we cannot directly observe this map-like form, called a mental map or cognitive map, etc. (Hart and Moore, 1971; Wood, 1973; Downs and Stea, 1973; Blaut, 1969; Blaut and Stea, 1969; Blaut, McCleary, and Blaut, 1970), we can witness evidence of its existence through man's behavior.



The formation of mental maps is a natural process that begins at birth. Navigational mental maps include those created during infancy, e.g., the path to the mother's breast, or to the bottle, and those formed throughout a person's life. Mental maps become storage places for abstract spatial data. For a child, these maps may include locations designated as dangerous, e.g., the kitchen stove, space heater, stairs. Later, the abstract data stored in mental maps might include delineations of residential areas in a city in terms of living preference. Political and economic notions about a city, country, and the world become part of man's mental map as he encounters more information about the environment.

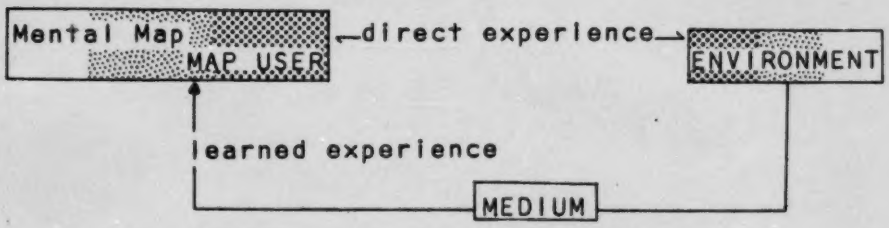
Mental maps are stored in our heads as reduced and generalized environment experiences that we have somehow coded. We can obviously not store all of our interactions with the environment. Therefore, we reduce the environment we interact with, select from and generalize our experiences of these interactions, and store the resultant information in some coded form as part of our mental maps. As children, we create mental maps that help us orient ourselves in our homes. Out of need (Downs and Stea, 1973), we later form mental maps of our neighborhood, the path to school, and the route to work.

These maps are our expressions of turf or defined portions of our environment. (Clay, 1973) Eventually these maps develop connections and begin to comprise an integrated network upon which we build with every new experience with the environment. Mental maps are used for navigation and the storage of data about the environment, and are, at first, the product of our direct contact or experience with the environment.

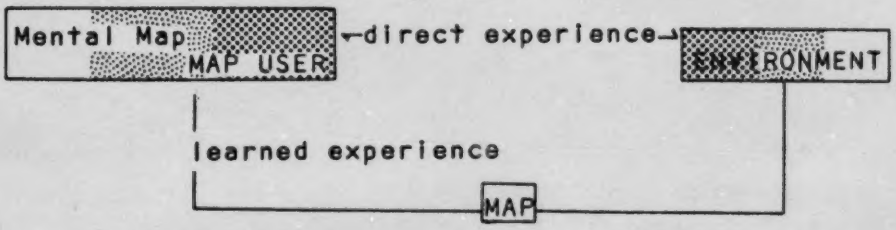


The Map as Medium for Learned Experience

Eventually, man finds the environment too large for comprehension through direct experience alone. To satisfy his need to know more about the environment, man seeks out ways through which he can have experiences of the environment without having to be in direct contact with it. Conversation, books, maps, pictures, and other graphic imagery are all mediums through which man is afforded information about the environment. In using these mediums, man is able to learn about the environment through vicarious experience. Vicarious experience is essential to man's understanding some things about the environment. For example, comparing economic trends of the world's steel industries is a task too large for direct experience alone. Man depends on some medium to help him perform such tasks. Thereby man expands his mental map to include the learned experiences he gains through mediums.



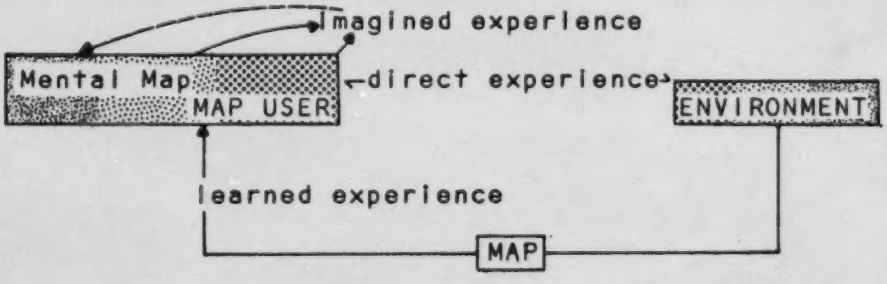
The map, as one source of learned experience, is the specific medium which is the focus of attention in the cartographic communication system.



The map, as a vehicle for communication, consists of information about the environment which has already been stored. Man's confrontation with the map results in experiences from which he can extract information to be assimilated into his mental map. The map enables man to expand his sphere of knowledge about the environment, adding to direct contact that information which he gains through learned experience. The processes of confrontation, extraction, and storage which take place during man's direct contact with the environment are the same as those which take place when man has learned experiences about the environment. Man, when he uses a map, reduces and generalizes his experiences of the map and stores the resultant information in some coded form as part of his mental map. These reduction and generalization processes are also the means by which man forms his mental map from direct experiences. In summary of the above, the mental map is the product of confronting, extracting, reducing, generalizing and storing experiences of the environment. All of the processes mentioned are part of the way in which man's mental map of the environment is formed.

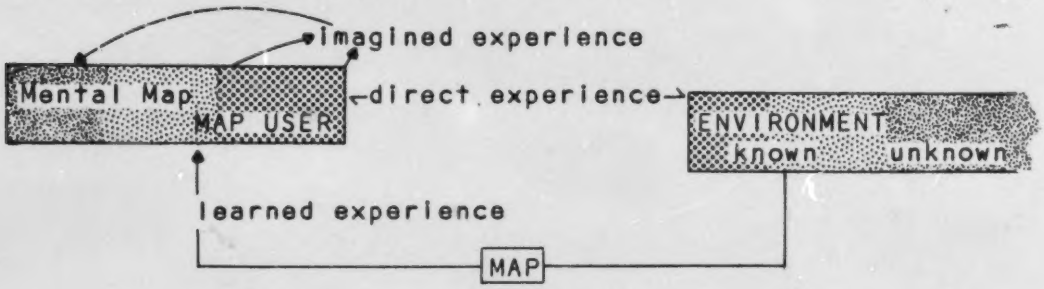
Environment and Mental Map: Parts Known and Unknown

That part of the environment which man directly experiences or experiences through learning constitutes man's known environment. Yet, direct and learned experiences do not make up the basis for all of man's mental map. There are, in fact, parts of the mental map which man develops through imagination. These imagined experiences usually have some root in a direct or learned experience. For example, we structure a mental map of our neighborhood as we experience it directly. Similarly, as we read an account of our neighborhood's appearance in 1856, we have a learned experience of the place. But if we think of what the same neighborhood area will be like sometime in the future, then our mental map of it is the product of an imagined experience.



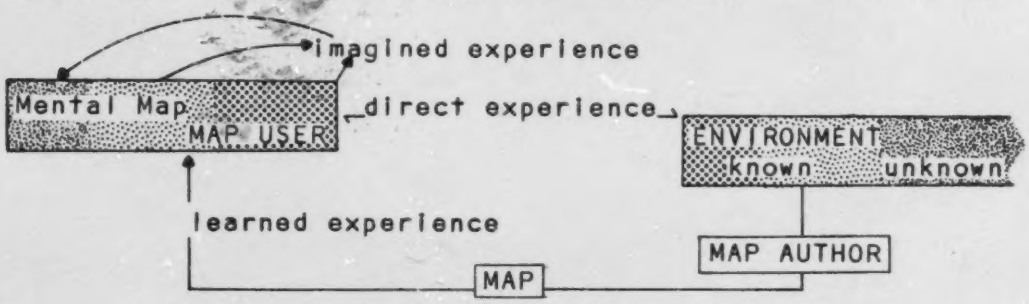
Combined, these three image types comprise our mental map of the environment. The limits of this mental map are

finite at any one point in time; although, in time, this mental map grows and changes with every new direct, learned, or imagined experience man has of the environment. The bounds of this mental map, however, are restricted in the sense that they will never encompass all the environment. A closer look at the environment will demonstrate why this is so. Direct and learned experiences can be shown as designating those parts of the environment which have become known to man. Imagined experiences are man's speculations of the unknown. However, regardless of how much of the environment man comes to know or imagine, there will always be an infinity that will remain unknown. Mental maps are representations of the environment, and representations are always less than the reality they depict. Therefore, man's mental map will always be something less than environment.



Map Author as Creator and Coder of the Map

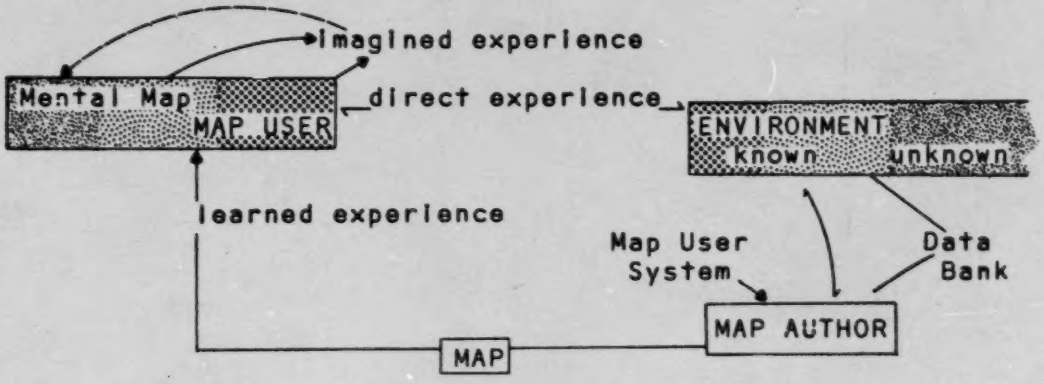
Although always less than environment, man's mental map can be expanded through direct experiences, and even moreso through learned experiences of the environment. The vehicle of communication from which man extracts learned information is the map. Maps are produced for two reasons: man, as map user, requests that his need for a map be satisfied, or someone anticipates a possible need for a map. In either case, the creator and producer of such maps is the map author.



The map author is the person who, based upon his own experiences, has an idea for the making of a map that will satisfy

either a petitioned or an anticipated need. "Map" here refers to a graphic representation of some phenomena in space. The map author is also a map user with his own mental map. Here, however, we are specifically interested in the map author's role as the creator and producer of the mediums through which man has learned experiences of the environment.

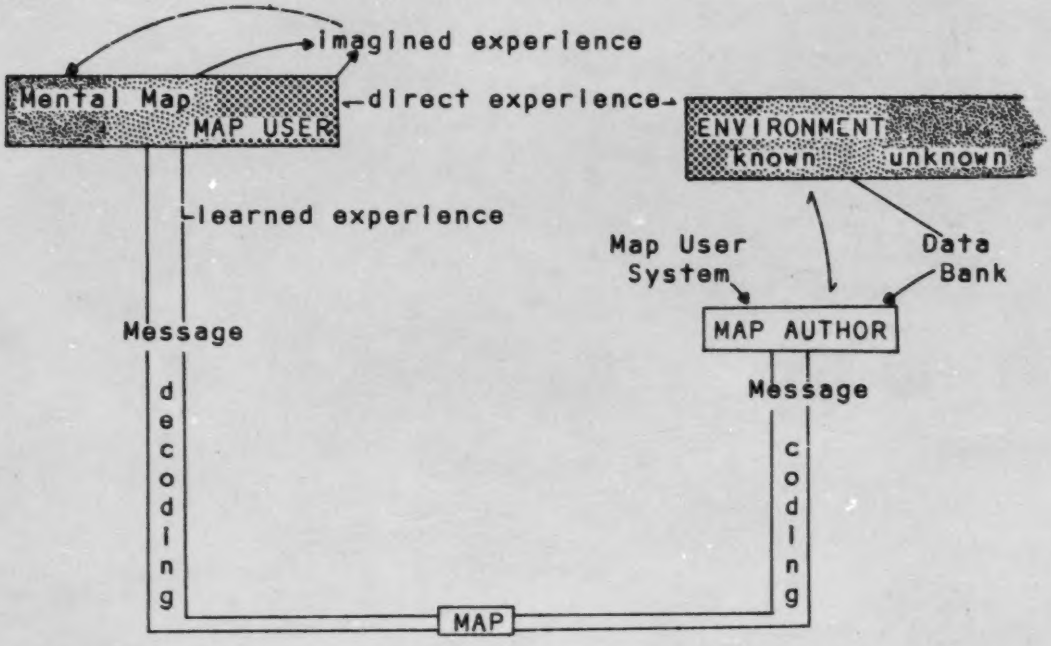
The map author, in preparing maps as communication devices, interacts with the environment; he has direct experiences. He gathers information from a stock-pile of maps and other materials concerning the environment, here called the data bank; he has learned experiences. The map author is also familiar with the way in which man makes use of maps, what is referred to in the model as the map user system, and he infers information about this system; this is a type of imagined experience. (In order to avoid unnecessary clutter in the diagram, labels for the map author's experience types are not included.)



Using all of these, and guided by the PURPOSE for which a given map is being made, the map author develops the message to be communicated. When the map author decides to transfer this message to a graphic representation, he extracts information from his mental map and from data available in the data bank; he reduces and generalizes the gathered information; and then, using some method of symbolization, he stores the information on a graphic artifact or map. These extraction, reduction, generalization, symbolization, and storage processes have been referred to in the literature as "coding" (Muehrcke, P., 1970). The map author is the person who codes information about the environment. He produces maps which serve as mediums for man's learned experiences.

But in order for the map user to have valuable learned experiences via the map, he needs to be able to use maps properly. If we examine the model closely in the light of the previous discussion, we note the similarity between the map author's preparation of a map and the map user's formation of

his mental map. Both interact with the environment. Both have learned as well as imagined experiences about the environment. In fact, both engage in coding when they store information in their respective map forms. For the map author, information is stored as a graphic artifact; for the map user, as a mental map. But what of the reverse of the processes, those engaged in during the use of a map? If, in making a map, information is coded; then, it would seem logical that when using, or extracting a message from, a map, such coding would need to be decoded. It is from the decoded message that the map user extracts information for his mental map. Therefore, the better a map user is able to decode a map author's message, the more accurate will be his learned experiences.

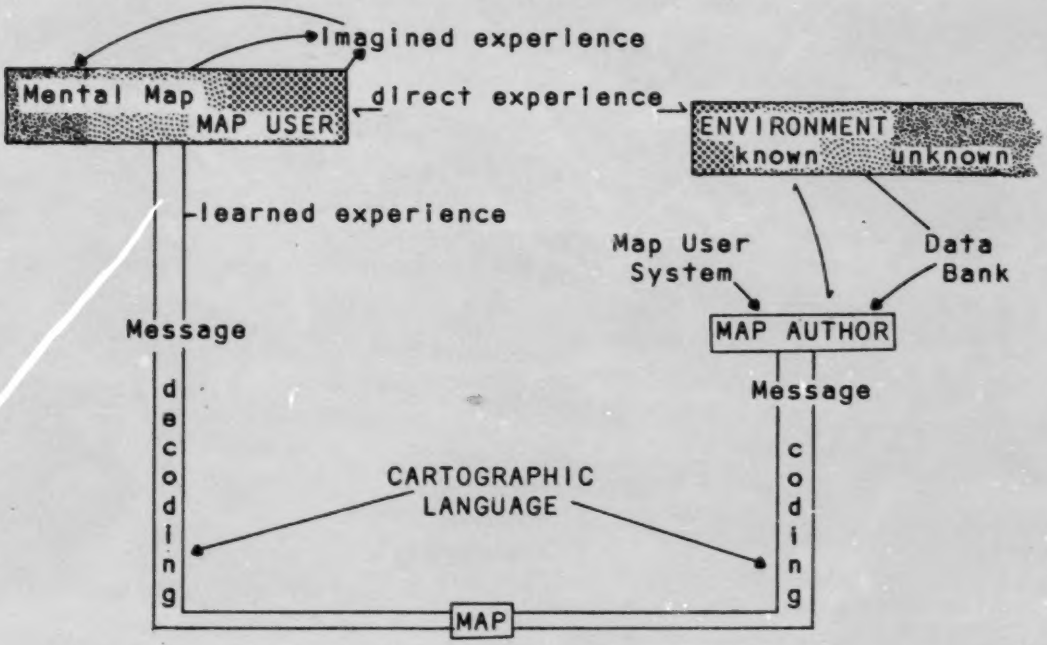


Last, But By No Means Least

There is yet one element that remains to be included in the model. It is the most important of all. Without it there would be no model, there would be no point in discussing cartographic communication. This one element is not a process, nor a participant in a process; it is rather that which allows the model to function. It is, as it were, the power supply for the system. This one element is cartographic language.

Cartographic language is the means by which the map author is able to express a message as a graphic artifact. The

extent to which a map user can accurately extract the map author's message from the map depends on the map user's ability to understand cartographic language.



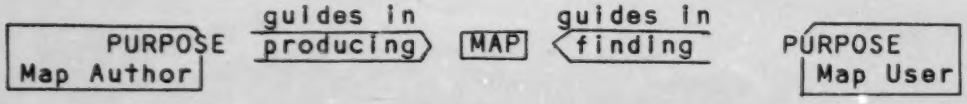
Everyone has some intuitive knowledge of cartographic language; after all, everyone makes maps. The map author uses cartographic language to produce graphic artifacts; the map user uses cartographic language to aid him in understanding graphic artifacts.

The important notion here is that there is no real assurance that the map author's use of cartographic language in placing his message on the map is going to produce a map that can be understood by the map user as indicating the same message. Although the processes of making and using maps both involve the utilization of cartographic language, there is a basic difference between them. This difference can prevent the map user from recognizing and understanding a map's message as it was intended. The varying abilities of map authors and map users to understand the other's needs, and to use or understand cartographic language account for the difficulties which arise in graphic communications.

The map author and map user engage in the dialogue of cartographic communication. The language that this dialogue requires is a highly specialized means of communicating an idea. Knowledge of this language, its tools and grammar, affords senders and receivers of graphic messages the necessary means to understand/communicate with each other. Impetus

for any graphic communication is PURPOSE, or the specific need for a map.

Purpose, the "idea" that a map is needed for some reason, activates the cartographic communication system. The purpose for having a map, once receognized, promotes the map author's work and guides his use of cartographic techniques and processes in the formation and completion of that map. Similarly, purpose begins and structures the map user's search for a particular map. Both map author and map user are involved in similar activities. Both, though from different perspectives, are interested in satisfying a mapping need. Both map author and the informed map user conclude their activities, if they are successful, by holding the target of their endeavors, a map. This relationship is illustrated below.



The reflective nature of the processes in which these individuals engage leads to this basic idea: that an understanding of mapping purpose and of the map author's decisions and procedures can make one a more effective map user, a map user capable of finding what it is that his need for a map demands. Cartographic techniques and processes, once recognized and understood, become the criteria on which the map user learns to analyze and judge his need for a map and the available solutions to his need.

But, as was noted in Chapter One, knowledge of purpose, cartographic techniques and processes is lacking among most map users. To allay this situation, we could consider entertaining the idea of introducing formal graphic/cartographic training in schools. Such training might be introduced in the classroom in the form of a simulation or game. For example, to grasp the importance of purpose within the context of the cartographic communication system, map users(students) could explore its role in the system from the vantage point of the map author. Therefore, we now turn to such a simulation.

CHAPTER THREE

THE "PLAY": SIMULATION MATERIALS AND STRATEGIES

No man can reveal to you aught
but that which already lies
half asleep in the dawning of
your knowledge.
The teacher who walks in the
shadow of the temple, among
his followers, gives not of his
wisdom but rather of his faith
and his lovingness.
If he is indeed wise he does not
bid you enter the house of his
wisdom, but rather leads you to
the threshold of your own mind.
(Gibran, 1951, 56)

"Now, Good Luck and Go to It"

Because purpose sets the cartographic processes in motion, it seems to be a key to the understanding of what these processes are all about. An examination of how the map author responds to specific needs, and how purpose plays a part in these responses provides a good focal point for introducing the study of cartography in the classroom.

However, this does not simply mean to "snowball" a group of students with a heavy assignment dealing with purpose in mapping; an assignment like the following is ineffective:

> You are to decide on a map that you want made. Tell us why you want the map, what you want on it, how you want what you want represented, and, based on the five pages that follow, give us a set of criteria for the map. Now, good luck and go to it!

An instructor would have to be out of his mind to use such an assignment, let alone to expect it to be carried out by his students. Exaggerated, true, but nevertheless this example makes a point. Somewhat reasonably it asks the student to examine his life-experiences to come up with some reason for having a map. However, feeling that one needs a map for a particular reason hardly implies that one would know how graphically to represent the satisfier for that need. As the example demonstrates, there would be too much noise, or pages of "items to be considered", to sort through before the criteria for the map could even be half-intelligently guessed at. Therefore, I propose to create a set of materials that can be used to demonstrate what cartographic purpose is, how important defining it is, what is necessary to define it, and what defining purpose ultimately means to the cartographic system. But, I propose to eliminate the noise entailed by those using professional jargon and deal instead with the demonstration by making effective use of the student's own life-experiences. I am suggesting the development of a simulation-game that will stress the importance of purpose within the cartographic context.

Getting at "Going to It"

The task now is to build a simulation in such a way that it will provide for the meaningful communication and understanding of this theme. Within the simulation a problem is identified; goals and rewards for the simulated activities are established; and materials for the simulation are provided

in full. Discussion of the simulation revolves around the materials and optional classroom activities.

The "Play", in Brief

The specific exercise I develop revolves around a mapping problem described in terms of an insurance company's search for a map depicting levels of fire risk. The company needs such a map to enable fire insurance rates to be set for property in an hypothetical town. Devising some measure for and producing a map of fire risk in a sample area of this town becomes the task to which participants in the simulation address themselves. Information concerning the nature of fire risk and materials describing the sample area are provided as the data base from which the final map and risk index are to be developed. These final products are then to be evaluated. They will be judged on their effectiveness in communicating the extent of fire risk associated with buildings in the sample area. On the basis of this evaluation, discussion of what goes into making a "good map" will be introduced. The exercise will be concluded as it provides a lead-in to more in-depth map-making studies.

The Simulation

My main goal is to provide teachers with some options for and possibly some insights to the teaching of cartographic communication at an introductory level. The materials for this simulation may be used in a variety of ways in the classroom. Some possible strategies for their use are outlined below in a general activity sequence for the "Play" of the simulation. The ultimate decisions regarding how these materials will be employed in any one classroom rest with the teacher of the class. The teacher's knowledge of his students, their background, and their receptability, is the primary factor affecting the use of any materials or strategies, if, in fact, they are to be used at all. I recognize that the most I can do here is to provide a set of materials and a number of possible strategies for using these materials. The teacher may review these to pick and choose, add, alter,, experiment with, or discard any part of them at his discretion.

Introducing the task

To initiate the simulation, the teacher must confront his students with a "let's pretend" situation within which the class will explore and endeavor to solve a mapping problem. First, the need for producing a map must be demon-

strated to the students. Simulation Material 1, SM 1, provides an expression of such a need in the form of a letter.

SM 1 Introductory Letter

To: Global Mapping Agencies

From: Fidelity Assured Inc., Research Committee

Dear Global Mappers:

Our firm has come to the uncomfortable conclusion that to date our fire insurance rates for Simcity, U.S.A. have been based on faulty and incomplete data. Our committee has been given the job of updating the company's rate-setting system. But, in order to do this we must first acquire an accurate set of maps which depict the nature of fire damage risk for the properties of Simcity. However, to date there have been no maps of this type available. Therefore, we are enlisting the service of your agency.

We wish to have you develop a sample fire-risk map of a one-block area in Simcity. This map, if successful in communicating something about the nature of fire risk, would later serve as a model for maps of the entire city. You and others have been asked to submit sample maps to our firm. The best of the samples received will determine which of the participating agencies will be awarded contracts with Fidelity.

We will provide for you any and all available information regarding the sample area and Simcity that might have some bearing on the production of this sample map. We would hope that this material could be organized and incorporated into a fire risk index which could then be used to map relative risks for properties in the area. For example, it is commonly known that a wooden structure is more likely to catch fire and be damaged than is a brick structure. The wooden structure is a greater fire risk. But what if we were to compare a wooden structure which has an internal alarm and sprinkler system and is located fifteen feet from a fire hydrant and within one block of a fire station, with a brick building positioned fifteen miles from the nearest hydrant? Which is the greater risk? The "fire risk index" we have mentioned would insure some method for comparing these two with each other. Your task is to determine such an index using whatever data you feel are applicable; and, then, to demonstrate, with a map, what this index can reveal about fire risk in the area. This map and the index it

represents will be used to determine if our company's city-wide mapping contract will be signed with your agency.

Recognizing our social responsibility to an ever increasingly interested public, we are also interested in fire risk maps of a slightly different nature. Whereas rate setting procedures (see Sanborn Atlases) have always been unpublicized, we find a need to make the public aware of how such rates are set. Therefore, we need to have maps that will be both of use to Fidelity Assured and of value to the public at large.

In thanks for your time and consideration in this matter, we await receipt of your finished map, and remain,

Sincerely,

Fidelity Assured Inc.
Research Committee

Option. Given this letter there are a number of alternative ways in which a teacher may decide to introduce the mapping task to his students. Copies of the letter may simply be distributed to the students, the letter may be read aloud to the class, or information from the letter may be paraphrased in some way by the teacher. Regardless of which method is chosen, it is of paramount importance that the students understand the specific task they are being asked to perform.

Understanding the nature of "risk"

Before having students attempt making maps of fire risk, the teacher may want to provide some information, in addition to the letter, about what such risk involves. The important aspect of providing this additional information is for the student to have a better grasp of the concept he has been asked to map.

Option. For instance, a fireman or insurance agent may be asked to speak with the class about the criteria on which they judge the likelihood of a fire occurring in any one place. Also, SM 2 and 3 demonstrate some notions of what fire risk entails, a letter from an enraged policy holder and a set of interview notes from a talk with an insurance agent respectively. Either, both, or some discussion of the contents of these materials may be used to help the student understand the nature of fire risk. Or, perhaps, the teacher would decide to speak to the students as a personal fire insurance policy holder. Discussion of why things burn

may be helpful to bring students into the simulation project. Students may look first at a specific object or building and examine it in terms of what would cause, add to, or prevent fire in it. Then, they may expand their examination to include adjacent buildings and areas, and finally arrive at a feeling for what the risk of fire would be in an entire region.

SM 2 In the public interest

To: The Editor of the Simcity Synthesizer

Dear Editor:

I am writing to express my distress about a situation over which I have no control. Recently, I bought a house in Simcity and set about getting it properly fixed up and insured. When the fire insurance rate for the house was evaluated, the amount I was told to pay was outrageous. I inquired as to why it was set so high and was told some things that really disturbed me.

Never having owned a house before, I was shocked to learn all the things involved in insuring property. I had expected that building materials, building use, and the locations of the nearest fire hydrant and fire house would be important to insuring my home. But I had not anticipated that the condition and nearness of my neighbors' houses would effect changes in my insurance rate. There is nothing I can do about it. My insurance rate is ridiculous because my neighbor still has not stopped burning trash in his back yard; and because he has not bothered to clear up the "junk" that had been discarded by previous occupants of his building. And there is nothing, ABSOLUTELY, NOTHING I can do about it.

I am sending this because I thought some of your readers might be interested in learning easily a lesson that I have had to learn the hard way. There is more to fire insurance than the condition of your own home. Thank you.

Signed,

Broke, but Insured

SM 3 A few notes

Interview with: Mr. John Ambrose Wiley, Insurance agent

Affiliation: Withheld

Subject: Fire Risk

Notes:

Important considerations include:

Construction of buildings--
wood has highest risk.

Type of business operated--
building with highly flammable materials (paint) about five times residential in risk.

Preventive systems lower risk--
sprinkler systems
alarms

Condition of property--
neat or cluttered

Space between adjoining buildings--
smaller spaces, higher risk

For residential property--
the more the occupants, the greater the risk

Condition of adjoining property

Use of neighboring buildings--
e.g. a bar would mean higher risk as attendant emptying ash trays might carelessly drop hot ashes into a paper basket.

Insurance rates set for commercial buildings by--
official inspectors
usually when building first begins operation.

Rates usually assessed with maps of property conditions--
confusing with many maps for one area
need a better system

Attacking the problem

There are a number of ways the teacher may choose to allow his students to attack the insurance company's problem. Students may be allowed to work individually or in groups as individual mapping agencies. Their task, in any event, would be for each agency to produce a map it felt would best serve the insurance company's needs. No restrictions nor suggestions as to the specific form the map should take are mentioned in the insurance company's letter for the express purpose of trying to free as many options for the students as

possible. The teacher is then free to allow students to take off on their own, or to make suggestions in specific directions. Again, the teacher's knowledge of the students with whom he is working becomes the major factor for how the students will be instructed to deal with the mapping problem.

Option. Working in groups allows students to pool many ideas and suggestions for their final map. For this exercise, large groups of five or six persons each can facilitate data evaluation by devising a system of labor sharing to accommodate the variety of tasks which must be performed. Division of labor by a large group of students results in more efficient and complete use of available resource materials than does the singular or small group effort. It might also be noted that by working in large groups, students would be producing relatively few maps. Therefore, the map evaluation procedure which students would later be asked to perform becomes greatly simplified.

Option. At this point, the teacher may introduce an element of competition into the exercise. He may inform the students that their maps, when completed, will be judged, and on the basis of this judgment, one agency will be selected to sign the city-wide contract with the insurance company. SM I is flexible enough that it allows for such a competition while not expressly stating that agencies are to compete. Thus, the teacher is left the option of having students work at whatever pace he wishes.

Option. In order to clarify the criteria on which the maps will be judged, the teacher may point out specific notions from the materials introduced thus far, i.e., the need for the development of a good comparative risk index, the desire to comply with the public demands for information, or the fact that neighboring buildings can effect changes in fire risk.

Option. The teacher may, in fact, run down a list of important criteria other than those included in the materials. For example, students may be told that map readability, in terms of neatness, simplicity, and clarity, are important to the insurance company.

Option. Perhaps the company is seeking some new creative and imaginative way to show "fire risk" on a map of Simcity. The teacher may then encourage students to use their imagination in preparing their maps. Possible suggestions for, or results from, such encouragement might include the use of cleverly devised symbols for fire risk, such as graduated

flame sizes, or color coded risk levels, or perhaps buildings would be shown in various stages of "burning up" to demonstrate their risk level. The possibilities can be as many and as wild as there are students and minds eager to "let loose."

The important notion in this part is that each student understands how the simulation is to be played, what his role is, and what rules are applicable.

Deciding upon what is necessary

Simcity and "the block"

Once the students have an understanding of what fire risk involves, the teacher may then begin introducing to the students information about the area to be mapped. SM 4 is a general description of the area's location in Simcity that may either be distributed or talked about in class. Within this brief description, a number of important fire risk factors are mentioned.

SM 4 Characteristics of the sample area

The sample to be mapped is a one-block area in the old industrial town of Simcity whose aging population is now about 100,000. Composed of a variety of building types and uses, the sample typifies the neighborhood diversity of downtown Simcity. Located in one of the town's oldest regions, most structures are at least 50 years old. All residential buildings in the area are multi-family homes, and are, with four exceptions, family owned. Dwellings are at most in the hands of their second or third owner, most having been passed down through the family over the years. Rents in the area are low, in fact, residents pay some of the town's lowest rents. The recent construction of a new interstate highway between the block and the center of Simcity has meant that low rents were necessary for tenants to be attracted to the area. People renting there tend to have low paying jobs, few luxuries, and an intent to make better and leave "the block" at their earliest opportunity. Therefore the population of this region, while owners may remain for the extent of their lives, is in a constant state of flux.

This transient characteristic of the residential population is also paralleled among the scattered small commercial shops in the area. Only three businesses located in the block have had a long-standing practice there. A few formerly commercially used buildings are

used for storage or stand vacant, awaiting their next occupant and whatever operation he might engage in to earn his living. Tell-tale ne'er removed signs indicate the histories of many of these closed and boarded buildings.

In all, the diversity of buildings in this area provides an ideal setting for our pilot mapping program. Addendum: It might be of value to know that Simcity has an overall "B" fire protection rating on a scale that ranges in the following manner.

"A" indicates a city where buildings are within at least 500 feet of a fire hydrant and 3 miles of the nearest fire station.

"B" within 1000 feet of a hydrant and 3 miles of a fire station.

"C" over 1000 feet from a hydrant, but within 3 miles of a fire station.

"D" over 1000 feet from a hydrant and over 3 miles from a fire station.

Other grades indicate areas that are essentially isolated.

Photographs: a primary source material

Another set of materials, included as SM 5, will probably become the primary source for information used on the students' maps. SM 5 is a collection of forty-four black-and-white photographs depicting buildings, streets, traffic signs, and other environmental data appearing in the sample area (see pages 33-43). Care was taken in preparing this set of pictures to include information that would be relevant to the fire risk mapping problem. Therefore, building materials, spaces between buildings, upkeep of properties, and location of fire hydrants and alarms are all illustrated.

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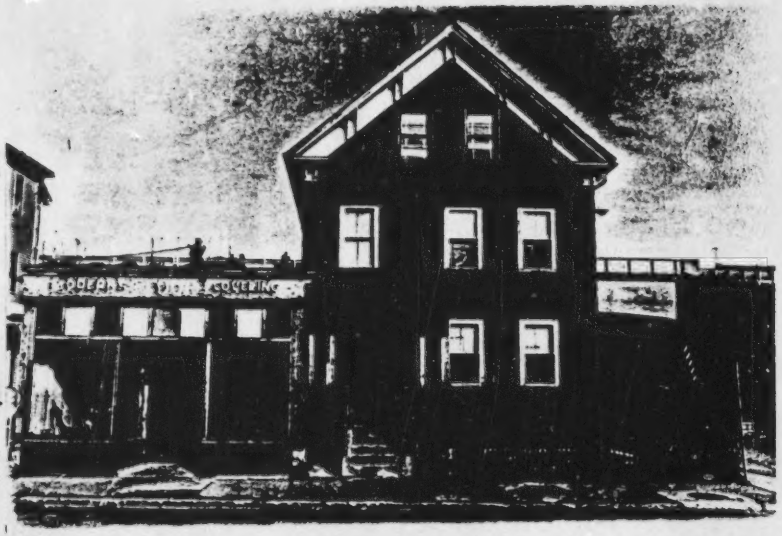

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13 14 15 16

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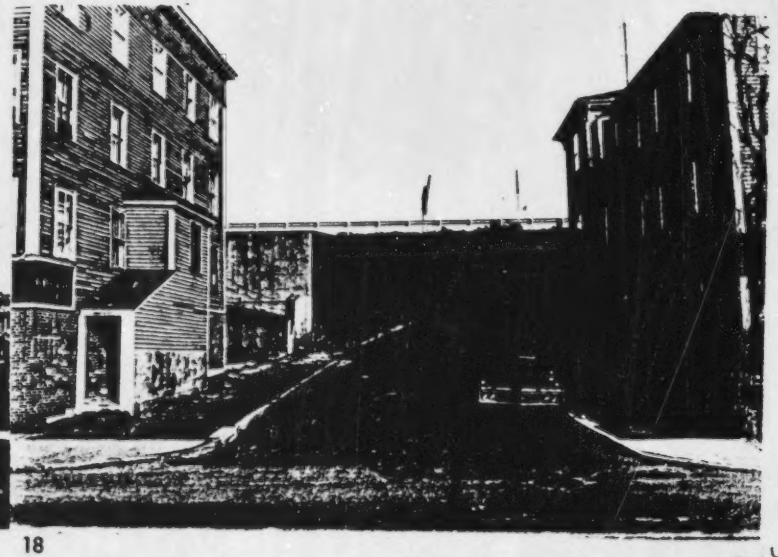

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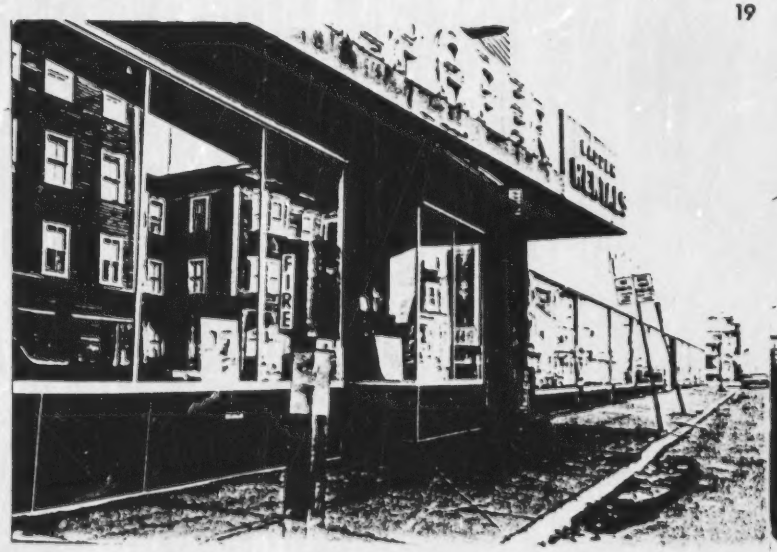

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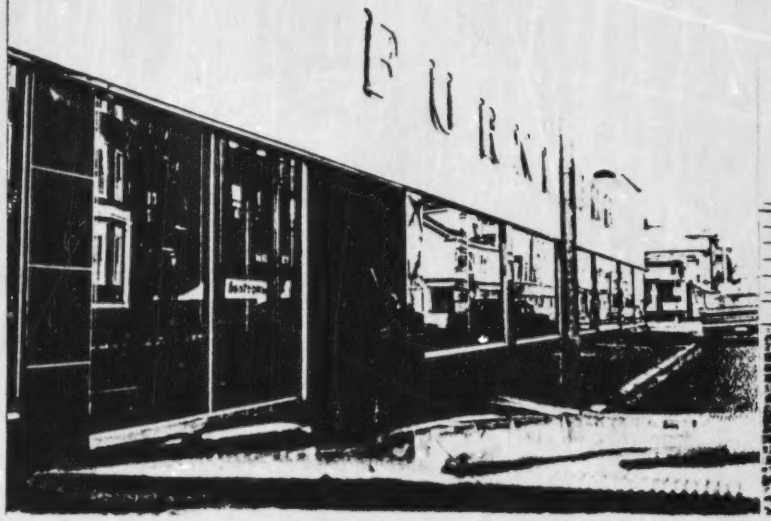

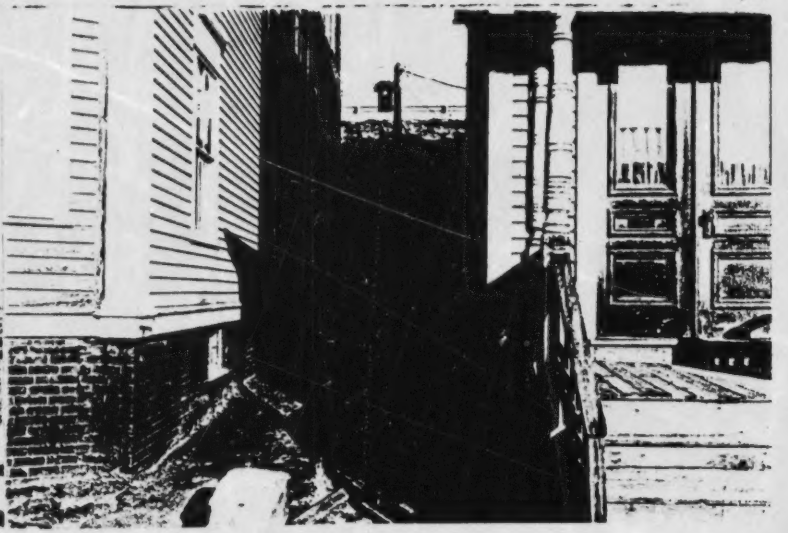

Bumpstead
Bumpstead
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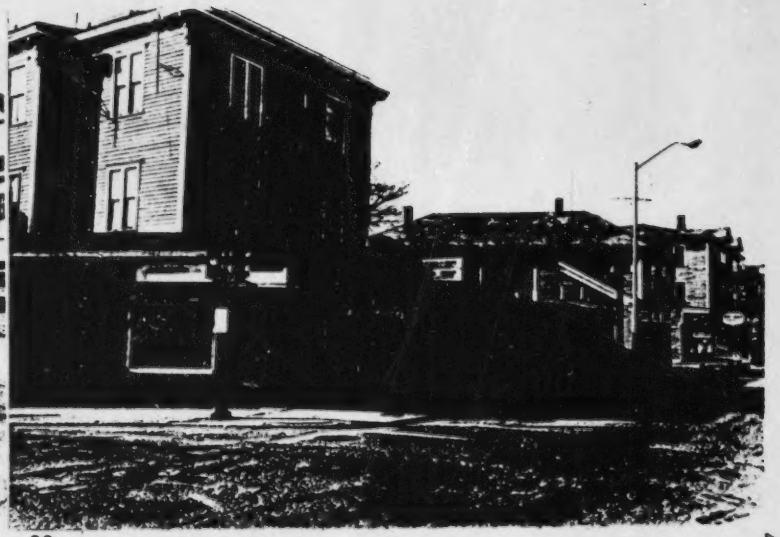

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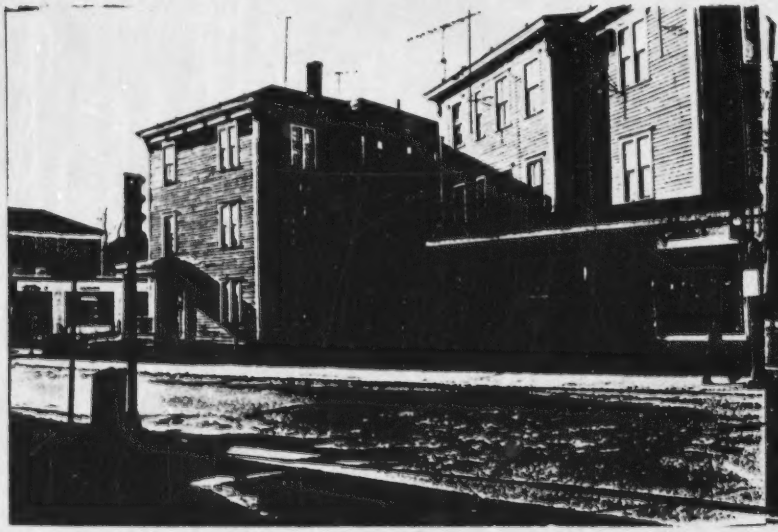

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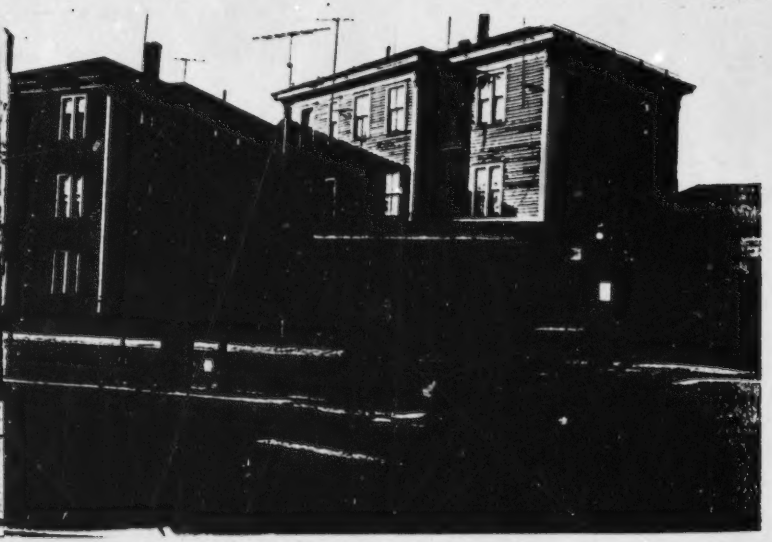

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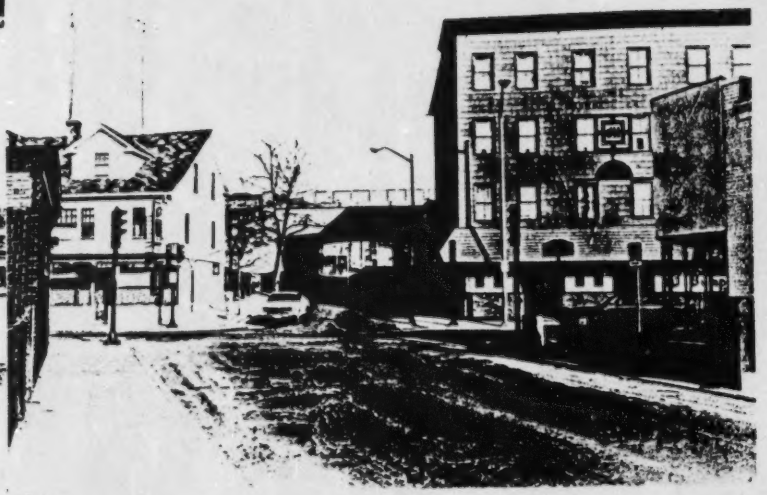

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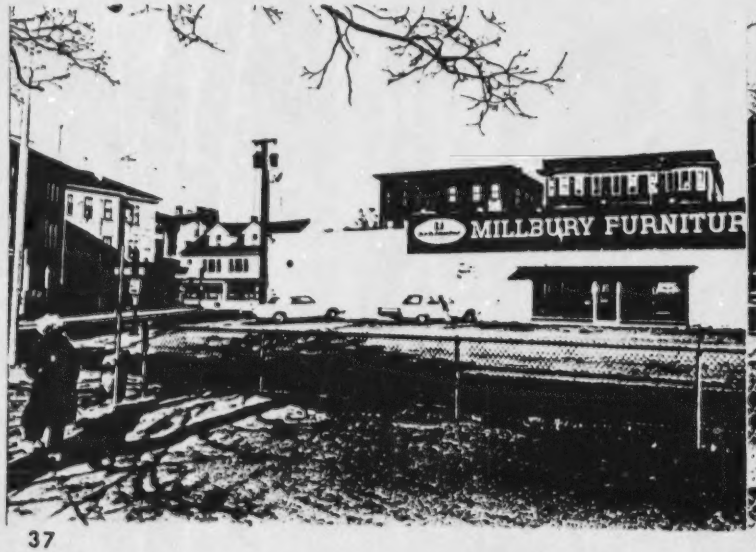

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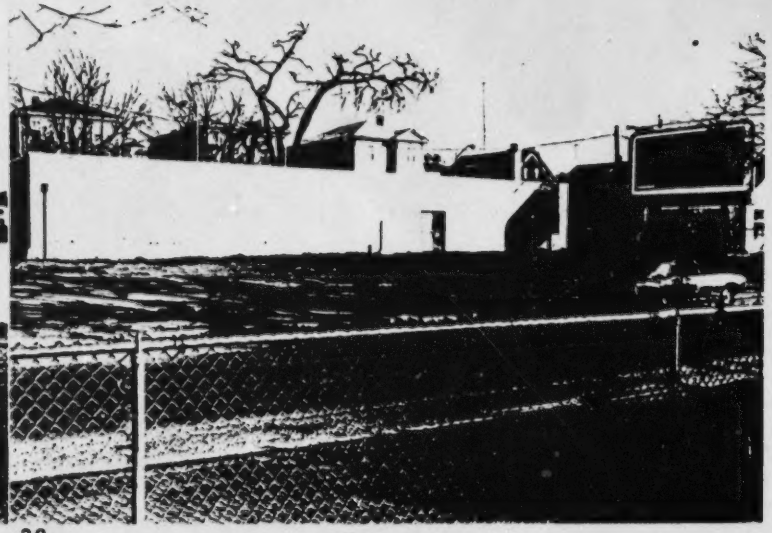

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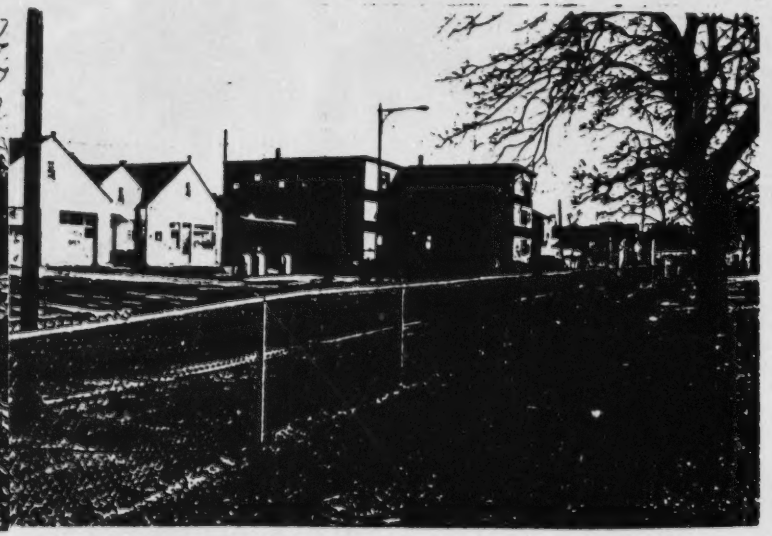

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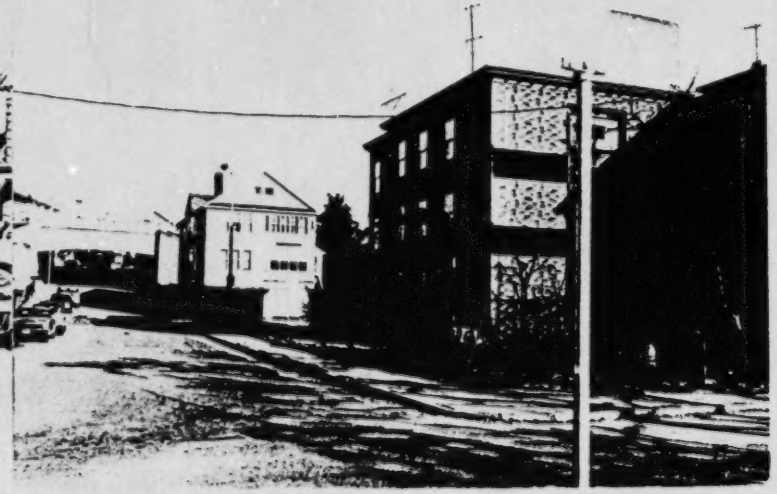

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Supplementary data: clarifying the photographs

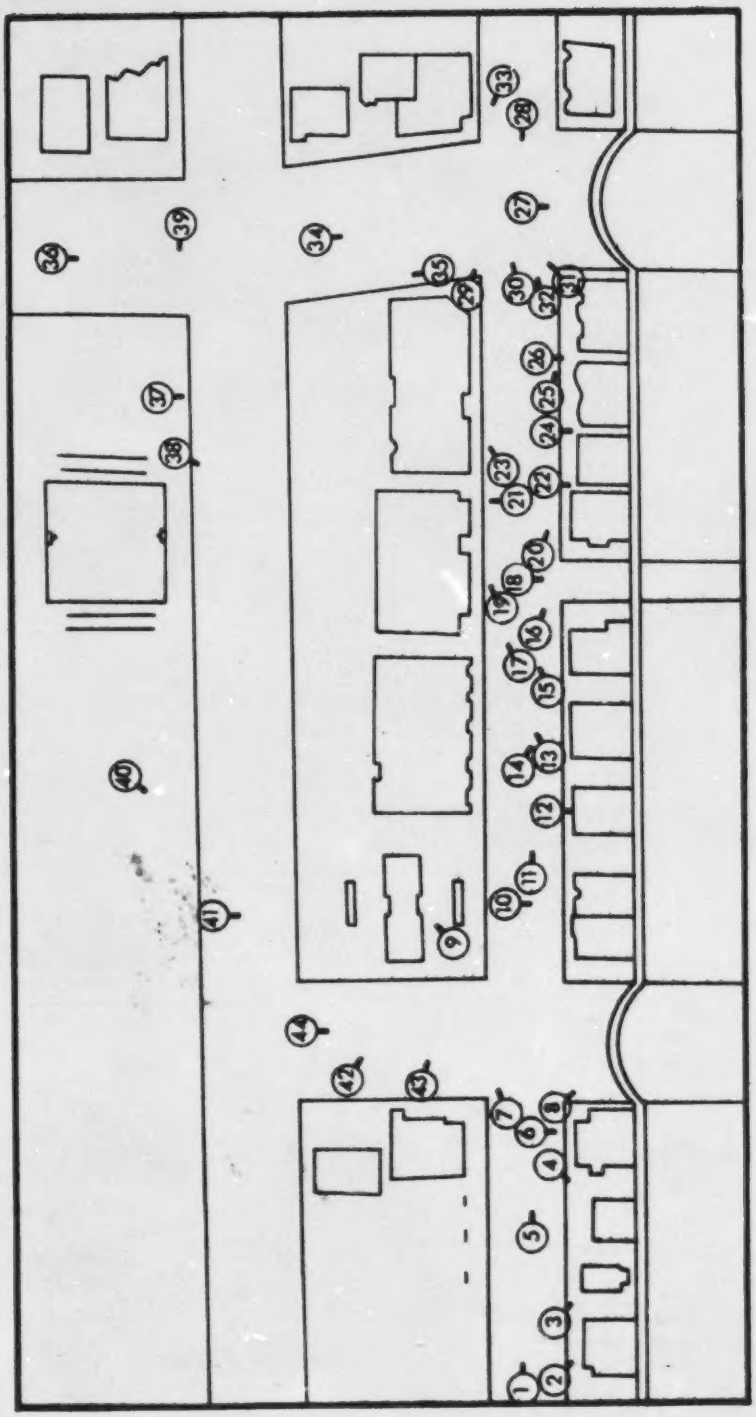
In some cases information that one would expect to be able to determine from the photographs is unclear. Note here that the Millbury Furniture building (T) is, in reality, made of brick and cement. This fact may not be recognized from the photographs alone. I have therefore prepared a set of data, SM 6 (page 45), as a supplement to the teacher's pictures. This data could serve as a base from which questions about what is in the pictures could be answered. I may have neglected to anticipate some of the questions that teachers will be asked about SM 5; for answers to these, I can only suggest that the teacher's best judgment be relied upon.

Additional information regarding the photographs is included in SM 7 and SM 8. Orientation of the pictures as they relate to the block is shown on SM 7 (page 46), a base map of the area coded with symbols representing the direction in which the camera was pointing for each picture. In order to allay some of the confusion that the orientation map might still leave for those using this simulation, I have prepared a list indicating the "featured" structures of each picture. This list comprises SM 8 (page 47). With these materials and a few blank base maps in hand, the teacher may want to play some games with the students to familiarize them with the sample area.

Option. For instance, using a blank base map of the streets pictured, SM 9 (page 48), or a base map showing relative building locations, SM 10 (page 49), the teacher may, using the pictures, play a "where is this?" or a "what direction does the traffic go here?" game with students. With a real sense of where things are and how the area fits together. students will then be able to start extracting things from what they see in the pictures for their risk maps.

SM 6 Teacher's photograph supplement

Bldg.	Use	# of Exits	# of Floors	Building Materials Wood	Cement	Brick	Combustibles
A	Electric repairs	4	3	1,2,3	Base		Yes
B	Vacant	0					
C	Residence	2	3	1,2,3		Base	
D	Vacant Store Residence	3	3	2,3		1,Base	
E	Dentist Office/ Residence	2	3	1,2,3		Base	
F	Vacant	1	1	1	Base		
G	Residence	2	3	1,2,3		Base	
H	Residence	3	3	1,2,3		Base	
I	Residence	3	3	1,2,3		Base	
J	Vacant Store/ Residence	5	4	2,3,4		1,Base	
K	Residence	3	3	1,2,3		Base	
L	Residence	2	4	1,2,3,4		Base	
M	Night Club/ Residence	4	4	2,3,4		1,Base	
N	Cafe-Bar/ Residence	4	3	2,3	1	Base	
O	Barber Shop	1	1	front		1,Base	
P	Residence	2	3	1,2,3		Base	
Q	Residence	3	3	1,2,3		Base	
R	Auto repairs	4	1		1		Yes
S	Residence	2	3	1,2,3		Base	
T	Furniture Showroom	4	1			1,Base	
U	Paint store/ Warehouse	4	3	2,3		1,Base	Yes
V	2nd-hand store/ Storage	6	1			1	
W	Gas, repairs/ Storage	5	2	part	1,2		Yes
X	Residence	2	3	1,2,3		Base	
Y	Residence	2	3	1,2,3		Base	
Z	Basketball court in park						



SM 7 Camera Orientation Map

SM 8 List of "featured" structures

Photograph	Features
1	street view, approaching block*
2	B,A *
3	D,C,B
4	D,C
5	street view with X,W...D,C*
6	D
7	W *
8	G,F,E *
9	W
10	F,E
11	street view with V,U...J,I*
12	G-F
13	street view with V,U,T
14	I,H
15	V-U
16	J *
17	V,U,T
18	J...I
19	U,T
20	N...M,L,K,J
21	U-T
22	K-J
23	T
24	L-K
25	N...M
26	M-L
27	N...M
28	street view with M...T*
29	street view with O...N
30	P,O
31	street view with R...Q.P,O
32	Q,P,O
33	T...
34	street view with O...N...M...T
35	street view with T...S,R...Q
36	street view with Q,P,O...N...T
37	Q,P,O...N...T (roofs of M,L)
38	V (roofs of I,H,G,E)
39	street view, showing park and Z*
40	W...X,Y
41	W
42	W...G,F,E
43	street view with W... I,H,G,F *
44	street view with ...D,X

All featured structures are listed as they appear on the photographs, left to right. The following symbols were used to help represent the information:
... indicates that a street separates the buildings
-- indicates that the space between buildings is featured in the photograph.
* some buildings in these photographs are not being shown with their letters due to their distance from the camera and their resultant obscurity in the photograph.

SM 9 Base Map

SM 10 Relative Building Locations

00057

More information is called for

There is some valuable information for assessing fire risk that is not evident in the materials presented thus far. For example, the presence of sprinkler systems, fire escapes, or gas heaters in any one building are all important criteria for fire risk that cannot be detected in the photographs or other information sources. Therefore, another set of materials, SM 11 (page 52), is provided. Whereas SM 6 includes information that can be inferred from the pictures, but may require clarification; SM 11 presents census-type data about goings on inside the buildings of the area. This data is of varying relevance to fire risk and is provided to allow students a wide choice of criteria from which to choose for their maps.

Three more materials are available for distribution to students. These include SM 12 (page 53), a map of traffic regulating signs in the block; SM 13 (below), a note regarding fire equipment and a notice about a special traffic restriction in the block; and SM 14 (page 54), a map of hydrants and fire alarms and including street names for the block.

SM 13 Notes of considerable interest

According to the Simcity Area Fire Equipment Company, fire trucks used in Simcity have the following characteristics:

unloaded weight	18,000 lbs.
loaded weight	26,500 lbs.
top speed	56 mph
overall length	305 ins
greatest height	97 ins
greatest width	96 ins

Simcity Traffic Commission Special Restriction

Re: Harding and Millbury Streets

Due to the water canal that runs beneath Harding Street, no vehicles exceeding 5 tons will be permitted to travel over the same. In order to allow for the safe passage and/or deliveries that must be made in this area, the following ordinance is provided:
Between the hours of 4 a.m. and 6 a.m., vehicles exceeding 5 tons in weight will be allowed to travel a detour route over Millbury Street. Because such travel will necessitate opposing "one way" regulations of this street,

officers will be on hand during these hours to control traffic flow. At no times other than those designated, excluding emergencies, will such travel be permitted.

Option. Strategies for introducing any of these materials in the classroom may include the following. The teacher may distribute all of the information provided and let students wade through the lot of it, picking and choosing as they will a set of "things" to be mapped.

Option. Alternatively, the teacher may withhold all information until it was requested by the students.

Option. Or perhaps the teacher may selectively distribute some materials to the class and allude to or present a list of other available information that might be obtained for the asking. Such a list appears below as SM 15.

SM 15 Simulation materials available

SM 1 Introductory letter, a need defined
SM 2 In the public interest, a letter
SM 3 A Few Notes, the insurance agent speaks
SM 4 Characteristics of the sample area
SM 5 Photographs, forty-four views of the block
SM 6 Teacher's photograph supplement, clarifying data
SM 7 Camera orientation map, where the pictures are
SM 8 List of "featured structures, in photographs
SM 9 Base map, blank street map
SM 10 Relative building locations, map
SM 11 Census data, more information about the block
SM 12 Traffic regulations map
SM 13 Notes of considerable interest, fire equipment and a special traffic restriction
SM 14 Hydrant and fire alarm locations, map
SM 15 Simulation materials available, this list
SM 16 The contract is yours!, a letter
SM 17 Thanks, but..., a letter

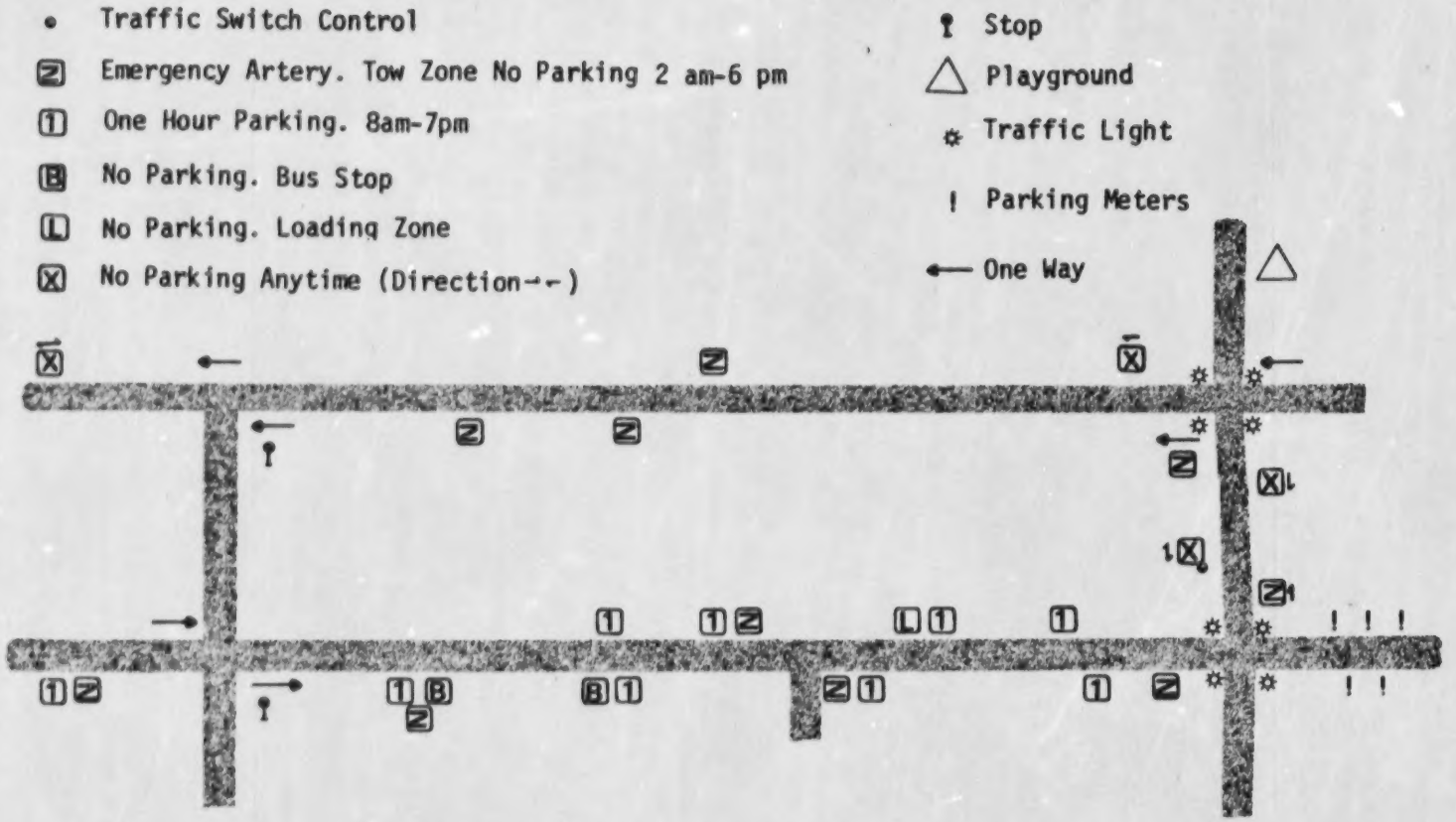
Option. If the students are competing with each other. other possible strategies arise. The teacher may choose to distribute information on the basis of closed discussions between himself and each indivioual mapping agency.

Option. Using the competition strategy may mean that some general information would be given to the entire class, while more specific data would have to be requested by the individual agencies.

SM Census Data

* Indicates affirmative

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	
2		3	2	2		3	5	4	8	4	8	6	2		5	6		3					3	3	families in bldg.
			*			*	*	*	*	*	*		*		*	*		*					*	*	children in bldg.?
							*	*	*		*				*	*		*					*	*	under school age?
									*			*			*			*							fire escapes?
												*	*						*	*					sprinklers?
*			*	*	*	*			*			*	*	*			*		*	*	*	*	*	*	extinguishers?
				*								*							*	*					internal alarms?
																				*					external alarms
E		0	0	0	0	E	G	G	G	0	G	0	0	G	G	G	G	0	G	G	G	G	E	E	heat-Gas, Oil, Electric?
						*	*	*		*	*				*	*		*					*	*	residential storage ok?
*		*	*	*		*	*					*	*	*				*					*	*	owner occupied?
*		*	*	*		*	*					*	*	*	*	*	*	*	*	*		*	*	*	metal safety containers?
*		*	*			*			*		*	*	*	*	*	*	*	*	*	*		*	*	*	exit lighting?
*			*			*			*		*	*	*	*	*	*	*	*	*	*		*			security doors?
									*												*				rodents?
				*			*	*																	burn trash?
*				*			*	*	*	*	*	*			*	*	*		*				*	*	smokers in bldg?
c	c	d	c	a	a	a	a	a	a	a	a	a	c	b	b	b	e	c	c	c	c	e	c	c	age of bldg. a - over 85 b - 75-85 c - 50-75 d - 50 e - under 50
*																	*			*					contains flammables?
A	A	A	A	A	F	A	F	A	F	A	F	F	A	F	F	F	F	A	F	A	F	A	F	F	roof, Flat, Angle



SM 12 Traffic Regulations

SM 14 Fire Alarms and Hydrants

00062

Option. The teacher may limit the amount of additional information that could be requested to four or five criteria, thus forcing students to decide which data would be the most critical for their maps.

Option. Members of individual agencies may be compelled not to share ideas or data choices with members of the class who are not in their agency. The teacher would then become the only person to whom all map plans are known.

Objective

Methods for distributing data to a class are many; only a few suggestions are mentioned here. The objectives for this part of the simulation are first, for students to have a feeling for what the sample area of Simcity is like; and second, for students to decide, on the basis of all they have learned about the area and fire risk, which criteria should be placed on their maps.

Option. A list of these things may be requested by the teacher before students are allowed to proceed with producing the actual map. However, students may very well be allowed to add or discard information as they proceed in the making of their maps.

Making the map

The teacher now needs to provide the students with time in which the maps can be produced. This work time may be utilized and structured in a variety of ways.

Option. Students may be instructed to freely experiment with the design of and symbol use for their maps.

Option. The teacher may instead decide to serve as a consultant for the class, giving advice where asked and suggestions where needed. If competing, groups may meet in private discussion with this consultant to decide on desirable mapping techniques.

Option. The teacher, as consultant, may choose to limit the number of variables that students would be allowed to incorporate in their risk index. For example, this might be suggested should a group complaining of difficulty show the teacher an index based on some measure of all the data provided.

Option. The teacher may suggest different methods

of portraying data on maps. For example, he may discuss the uses of shading and color, or of the more involved graduated and segmented circles for data representation. Such discussions may be facilitated with information from cartography texts (Robinson and Sale, 1969), or by examining symbol use on other maps. The depth to which the teacher carries this mapping procedure depends primarily upon what the teacher feels his class can handle.

The essential result at the conclusion of the proposed work time is for each agency to have produced a map that can be submitted for evaluation.

Evaluating the map

Once each agency has produced a map, the next task is evaluation. For the competitors, this means determining which agencies will sign the insurance company's contract. Possible evaluation schemes are numerous. Here a few methods are briefly sketched. The teacher might choose to enlist the students' aid in deciding upon a map evaluation strategy for the class.

Option. Maps may be collected, judged and ranked by the teacher or some outsider, e.g., a fireman, insurance agent, or the school principal. The results, as well as the criteria used by the judges would be submitted to the class for discussion.

Option. Alternatively, the maps may be collected, posted on a board, and ranked by the students. Either individually or in their agency groups, students could decide which maps are better fire risk representations. Students would be asked to devise sets of evaluation criteria with which they could make ranking judgments and to submit these criteria with their map rankings for later discussion.

Option. Yet another way to accomplish the evaluation task is to have students form groups of judging panels composed of an equal number of members of each agency. This strategy is directed primarily at those situations in which maps were produced in groups. If, for example, there had been six agencies of five persons each in a class thirty; then, there would be six judging panels composed of one member from each of the agencies or three judging panels of two members from each agency. These judging panels would be instructed to draw up a set of criteria on which to evaluate the maps and then proceed to rank the maps. Again criteria and ranking would be submitted to the class for discussion.

Some suggestions for what might be included among these criteria could be given by the teacher.

Option. Students may be reminded that they should view the maps as the insurance company people would view them for use in setting insurance rates.

Option. Or students may be encouraged to evaluate the maps in terms of their appeal to the public at large.

Option. Neatness, clarity, and originality of design may be pointed out as important map features.

Students should be allowed to develop some notions of what makes a map a good communication device on their own. Note that whereas the nature of the "risk index" will enter into the discussion of the maps, the teacher should take care that criticism of the index does not dominate the students' commentaries. The index is important to the mapping problem in terms of its success as a fire risk indicator. However the nature of variables taken into account in forming the index are of secondary interest within the map evaluation procedures.

Most important in this section is that students be encouraged to vary their ranking criteria. Depending upon the perspective taken, ranking results could differ greatly. Such variations or differences will strongly emphasize the role of purpose in map-making.

Discussion of the evaluation results

Results of the evaluation activities should be compiled and presented to the students.

Option. The teacher may then choose to distribute copies of SM 16 or SM 17, letters notifying the agencies of Fidelity's decisions regarding its city-wide contracts.

SM 16 The Contract is Yours!

To: Global Mapping Agencies

From: Fidelity Assured Inc.

Dear Global Mappers:

Evaluation of the map your staff produced for us has been completed by our Research Committee. On the basis of the outstanding work done on our pilot project,

we are pleased to offer the Simcity mapping contract to your agency. We had recognized that the assignment was difficult and unprecedented in its kind when we first suggested it to you. Your work is truly an accomplishment. Please extend out sincere thanks to your staff for their long hours of hard work.

Sincerely,

Fidelity Assured Inc.

SM 17 Thanks but . . .

To: Global Mapping Agencies

From: Fidelity Assured Inc.

Dear Global Mappers:

Evaluation of the map your staff produced for us has been completed by our Research Committee. For the outstanding work done on our pilot project, we wish to thank you. We had recognized that the assignment was difficult and unprecedented in its kind when we first suggested it to you. Therefore although we cannot offer our mapping contract to your agency at this time, we would like to extend our sincere thanks to your staff for their long hours of hard work.

Sincerely,

Fidelity Assured Inc.

With the sets of results and criteria collected from the various map evaluators in hand, students should be allowed to review and discuss the evaluation procedures. This discussion is the climax of the simulation. It may take place in the class as a whole, in groups, or through some method, e.g., panels, written evaluations, etc., of the teacher's own design. Within these discussions the activities of the simulation should be brought together and shown as an integrated whole. Criteria used for judging the maps should be looked at in the light of the original assignment. The different ranking results should be examined and compared with the criteria used to determine them. In comparing the results and criteria in this manner, students would actually be exploring the role of purpose in map-making. The teacher may even choose to bring the term itself into the discussion to further the

students' awareness of the concept's importance.

To help foster this type of discussion there are a number of questions that may be posed for the students.

Are there differences among the ranking results?

Are there differences among the sets of ranking criteria?
Why might there be differences?

Is there any correspondence between ranking criteria and ranking results that you can explain?
We assume that the ranking results are based on the given ranking criteria, what might the criteria themselves be based upon?
Are different sets of ranking criteria based on different perspectives of the assignment?
Might these different perspectives also be referred to as different map PURPOSES?

If we look at the maps produced by the class, we can postulate what the purposes of these maps might be.
The evaluators also, using their criteria, made such assumptions about the maps' purposes.
However, perhaps we should consult the map authors themselves to learn what they had in mind when they designed the maps.
Did you, as map authors, feel that the criteria used to evaluate your maps were appropriate to the purpose for which you were making your maps?
How might the judging criteria have been more related to your map purpose?
How might you now alter the characteristics of your map and why?

Finally, in concluding the simulation exercise, the teacher may question the class about the types of knowledge or skills they felt would have helped them make better fire risk maps. There are many suggestions that might arise from such an inquiry. In asking students to make maps, I have often found that frustrations were expressed in terms of the students not really having any feel for how to make a good map. The point to be made here is that there are avenues of knowledge that could improve the fire risk maps that the students prepared.

The objectives in this section, and in the simulation as a whole, have been to conclude the exercise with a discussion of purpose and how it relates to the students activities as map authors; to shed some light on the broader

scope of knowledge that the field of cartography commands; and to encourage student-initiated study of cartography. The common experience which the simulation provides serves as a base from which the teacher and class can proceed. Throughout the simulation, spin-off topics in more specialized areas of cartography have been introduced. These topics, brought to light by the students' questions about the fire risk mapping task, may determine the direction of further cartographic training. Students have become familiar with cartographic terms and concerns. They have developed a sense of problem about mapping tasks. Essentially, through the simulation the ground has been laid for the study of cartographic communication.

CHAPTER FOUR

ANOTHER LOOK AT THE SIMULATION

Every hour Jonathan was there
at the side of each of his stu-
dents, demonstrating, suggesting,
pressuring, guiding. He flew
with them through night and
cloud and storm, for the sport
of it . . .
. . . When the flying was done,
the students relaxed in the
sand, and in time they lis-
tened more closely to Jonathan.
He had some crazy ideas that
they couldn't understand, but
then he had some good ones
that they could.
(Bach, 1970, 110-11)

The need for graphic language instruction, for cartographic education, has been argued. Methods of promoting such instruction have been examined and explicated by analogy to verbal language instruction. A proposal that an experiential teaching technique be used for introducing the study of cartography has been advanced. In answer to this proposal, a simulation has been developed, including materials and a variety of possible strategies for implementing the simulation. That which remains to be discussed are the evaluation of and the conclusions drawn from the simulation.

Evaluation of the simulation can take place on three levels relating to its consistency with the Cartographic Communication System described in Chapter Two. First, the simulation can be viewed as an exercise in decision-making; second, as an indicator of the complex nature of map production, prompting further investigation into the field of Cartography; and third, as an experience involving the art of self-expression, communication in a graphic form.

There is another type of evaluation that should also appear here. Does the simulation work in the classroom? It is unfortunate that time and circumstances have not allowed this simulation to be tested in the classroom. Such testing is beyond the scope of this paper. It is hoped that teachers, finding this exercise of value to them, will use, criticize, alter, and improve upon the materials and strategies I have set down. I will welcome any correspondence regarding the simulation. I look forward to having the opportunity to use this simulation in the near future.

As a Decision Making Exercise

The simulation is an exercise in cartographic decision-making. Within the simulation, students are presented with a wide variety of information concerning a one-block sample area in Simcity and are given the task of constructing a fire risk map of this area. This task implies the making of numerous decisions. Students are asked to select, define, and compile criteria which they decide are needed to measure fire risk and to form a risk index. Once the index is determined and buildings within the sample area are evaluated in terms of this index, the students are then faced with the challenge of how to make their map. How is the index to be represented? How should the base map be drawn? What labels are needed? Are "one way" signs really that important? All are questions to which the students must address themselves before their maps are completed. All are part of what the map author is concerned with as he codes information in

producing a map. Yet, the student is still further called upon to make decisions regarding map evaluation and improvement. The simulation is, indeed, an exercise in decision-making, cartographic decision-making.

As an Indicator of Mapping Complexity

The choices with which the students are presented and the obstacles they encounter within the "play" of the simulation correspond directly to the decisions and challenges that map authors face in producing maps. The students have been instructed to perform the roles of map authors. They create and produce a map which is the response to a petitioned need on the part of Fidelity Assured Inc. The students have been asked to grapple with understanding the nature of the map's purpose: to show fire risk in the sample area of Simcity in order for an insurance company to set insurance rates for buildings in that area and to indicate a method of representing fire risk in a map form that could be applied elsewhere.

The students have had to utilize knowledge of this purpose, of their intended map users, and of the sample environment of Simcity in order to make their maps. They have vicariously confronted this environment through materials composing a Simcity data bank. They have, on the basis of these confrontations, extracted information from their experiences of Simcity. After reducing and generalizing the information, the students then, in some way, symbolized and stored it on a map. The students did, in fact code information about Simcity on a graphic artifact, using cartographic language to do so. Students experienced the role of the map author in communicating graphically and were witness to notions about the complexity of mapping. If questioned about what knowledge would have helped the students make better maps, surely the students would have numerous replies. I have always found with myself, as well as with my students, that there is always something else that might have helped to make a map better understood, easier to produce, or less expensive to complete. The added techniques or skills that students feel would have helped them with the fire risk maps are the spin-offs into other areas of study in Cartography that might encourage a student to continue study in the field.

As an Exercise in Graphic Communication

As map authors within the simulation, the students were instructed to perform a variety of activities. The students were themselves using their intuitive knowledge of carto-

graphic language and the map user system in making their maps. The students were communicating graphically.

Through their examination of the maps and the map evaluations, students were faced with the many factors that become important to a map author. Data collecting and sorting, reduction, generalization, symbolization and design have all become real experiences to the students, even though the terms themselves may still be unfamiliar to them. The students, by merely recognizing that the purpose for a map guides the map author's endeavors in making that map, develops a better sense of what maps are. He expands his decoding abilities. And, he therefore also extends the bounds of his knowledge of graphic/cartographic language.

In conclusion, the simulation can be seen as a medium through which students can become better map users. All too often, maps are looked upon as the graphic representations of truth and are rarely ever questioned. The very nature of their complexity seems to give way to the confirmation of their validity. With no understanding of cartographic language, limited available tools for deciphering graphic messages, and no knowledge that such understanding and tools are necessary for accurate interpretation of graphic representations, man falls short of learning all that he possibly could from a given map. He lacks comprehensive fluency in graphic language and falls prey to those who would abuse his ignorance. Exercises like the simulation provide a means through which man can become a better, more effective map user. Through the simulation, one learns how map authors use their knowledge of cartographic language to make maps and, in turn, one also learns to use his knowledge of cartographic language to interpret maps. Thus it is that the simulation can be a step toward graphic fluency.

"Breaking a little ice
may eventually lead
to clearing the entire pond --

Spring is at hand
and soon the time will come
for diving in all the way."

April 1974

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